



Section 3

Strengthening Finance, Insurance and Market Information

Credit for small farmers in Africa revisited: Pathologies and remedies¹

Hans P. Binswanger^{2,3} and Rogier van den Brink⁴

Abstract

Developing successful rural finance institutions has been one of the most intractable issues in development. This paper reviews the generic difficulties confronted by rural finance and proposes a way to overcome them by combining a number of features of successful micro-finance institutions with (1) farmer-owned insurance funds at village, district and national levels; (2) insurance of national catastrophic risks in national insurance markets; and (3) international insurance.

Introduction

Africa desperately needs poverty-reducing economic growth at far higher levels than currently prevail. It is difficult to see how this can be achieved without increasing private investment in agriculture and improving access of farmers to agricultural credit, in particular medium-term credit. Nevertheless, since the late 1980s, many countries and donor organizations have stepped back from targeted agricultural credit programs, given the extremely poor track record of such programs the developing world over (e.g., Von Pischke, Adams and Donald, 1983; Adams and Fritchett, 1994; Besley, 1994; Mathieu, 1998; OED, 1993; Yaron, 1992; Yaron et al., 1998). And even in developed countries, their track record is sometimes hardly any better. This paper revisits the reasons for the failures of the past and suggests a set of possible remedies for the future.

We first analyze the main theoretical and empirical reasons for the past problems of medium-term credit provision to farmers in developing countries. These include the following generic problems: (i) low demand for credit; (ii) heterogeneity; (iii) seasonality; (iv) covariant risks; (v) moral hazard⁵; (vi) inability of crop insurance to solve the combined problem of co-variant risk and moral hazard; and (vii) difficulty of mortgage lending based

on individual farms, as well as group assets⁶. We then suggest a number of specific solutions to the generic problems, based on theory and empirical evidence. Finally, based on this analysis, we design a hypothetical agricultural credit program – the Community Trust Bank. We conclude by a call for trials, piloting and action research into the feasibility of the proposed solution.

Generic problems

Low demand for credit

One reason for the failure of many well-intended agricultural credit programs stems from a fundamental – and economically rational – lack of demand, given the incentives farmers face. For instance, in land-abundant situations, soil fertility conservation may be more cost-effectively achieved by shifting cultivation under a long fallow system, leading to a lack of demand for the type of inputs associated with agricultural intensification (Pingali et al., 1987; Binswanger and McIntire, 1987). Low demand for credit can be the result of the low profitability of agriculture and the high transactions and transportation costs farmers face. In areas of low population density farmers may have difficult access to markets (e.g. distance, lack of transportation infrastructure), which increases farm gate prices for inputs and lowers prices for outputs (Sadoulet and de Janvry, 1995). And in yet other cases, profitability can also be low because of the existence of monopolies and monopsonies in input and output markets, which discriminate against small farmers.

Heterogeneity

In Sub-Saharan Africa in particular, extreme heterogeneity raises transactions costs and aggravates asymmetric information problems, as well as resulting moral hazard problems (Binswanger and Rosenzweig, 1986). For instance, even within a particular agro-climatic zone, differences between villages, farmers and plots can be great. Between villages there may be substantial differences in micro agro-climate, rainfall in a given year, infrastructure, and access to markets. And within a village, the farming community may be very heterogeneous in terms of assets, income, managerial capability, age and gender. Even rainfall may differ from one end of the village to the other. And individual farm plots may again be very different in terms of soil

¹The paper was published in *Savings and Development* Volume 29, No 3, 2005, pp. 275-292. Reprinted with permission. Comments on an earlier draft from Abayomi Alawode, Sherri Archondo, Demba Ba, Gerard Byam, Gershon Feder, John McIntire, and William Steel are appreciated.

²Hans Binswanger is a retired World Bank staff member. His last position was Senior Advisor to the Vice-President of the Africa Region.

³Corresponding author (binswangerh@gmail.com)

⁴Rogier van den Brink is Land Reform and Land Policy Coordinator for the Africa region of the World Bank.

⁵A glossary of technical terms is provided at the end of the paper.

⁶Yaron (2004) also reviews these and additional barriers to financial intermediation in Africa, as well as numerous approaches and examples of how to overcome them.

types and position on the slopes of the watershed area (Chavas, Kristjanson and Matlon, 1991). Any credit provider who is not a village “insider” would therefore face substantial difficulties in collecting information about prospective borrowers *ex ante* and assessing the borrowers’ true efforts in paying back loans *ex post*. Hence, the transactions costs of operating a credit scheme by such outsiders would be substantial, and issues of moral hazard and adverse selection will constrain the successful operation of the scheme. Communities, on the other hand, are “insiders” and do possess the necessary information about individuals’ repayment capacity and trustworthiness.

Seasonality

The agricultural marketing chain from farmer to market is characterized by severe seasonality problems, as the following stylized description illustrates. At the start of the growing season, farmers want to borrow, or withdraw their savings, to buy inputs. This leads to a liquidity crunch in local-level financial institutions. Savings will be withdrawn *en masse*, while no new deposits will be made available out of which to lend. At harvest time, a similar liquidity crunch develops, because when agricultural traders want to borrow to purchase the new crop, farmers cannot have yet deposited the proceeds from their crop sales. Finally, in the run-up to the next rainy season, input merchants want to borrow for inputs before output merchants have deposited the proceeds from their crop sales.

The group lending procedures, regular and frequent repayment schedules, and regular savings obligations used by micro-finance institutions to increase repayments and improve client and institutional performance means that micro-finance is not well suited to clients with seasonal farming activities (Gine, 2004). But seasonality also has severe negative consequences for local financial institutions. Liquidity management is very difficult, as the peaks and valleys of credit demand and supply cascade throughout the agricultural cycle. Local agricultural banks will need very high reserves to manage during the peak periods, but these same reserves will then sit idle during the valley periods. This liquidity management problem becomes especially severe when there is only one season.

Covariant risks

These imply low financial intermediation. Potential borrowers in the farm economy typically face common shocks – covariant risks

– from a number of sources (e.g., the weather, pests, and prices). They therefore have great difficulties in guaranteeing credit for each other. And their problems become especially severe when there are several common shocks in a row. These covariant risks typically undermine group-lending schemes. Again, to avoid insolvency, a local financial institution would have to hold very high reserves. Conversely, private moneylenders are therefore often seen to be lending out of equity, not out of deposits, and have “reserve ratios” of 100% (Binswanger and Rosenzweig, 1986; Binswanger et al., 1993).

Seasonality and covariant risks together explain why the micro-lending successes are largely concentrated in irrigated areas, with lower agricultural production risks than dry-land agriculture, or in periurban areas, where there is a significant non-farm sector, which does not exhibit covariance with the farm sector. The successful Grameen Bank programs in Bangladesh confirm this pattern. Lending to its members is mainly for low-risk activities with a regular income stream, e.g., trading and other non-farm activities, and the purchase of milk cows (Khandker, 1996). In rural areas in Africa, indigenous financial institutions, such as Rotating Savings and Credit Associations (ROSCAs), diversify their membership (e.g., include a mix of professions and occupations) in an attempt to diversify risk (van den Brink and Chavas, 1997). Finally, we have been unable to find a successful micro group-lending scheme that lends for dryland agriculture.

Moral hazards

These result from asymmetric information⁷. The term “moral hazard” describes the opportunistic behavior of a borrower who exploits the lack of information by the lender. With respect to farmers, the type of moral hazard and asymmetric information that is typically associated with farming is best illustrated by the popular caricature of the farmer, who is always poor, eternally subject to bad weather, or, when the weather is good, bad prices or exploitative traders.

Moral hazard is a constraint to lending to individual borrowers anywhere. But in rural areas it is compounded by heterogeneity and high risk. In addition to constraining individual lending, farmers sometimes collude collectively when they claim, as a group, to be affected more severely by adversity than is the case in reality. Only if there is a massive, clearly observable and verifiable drought or flood does the asymmetric information

⁷There is large literature that analyzes how informational problems produce the key market imperfections that plague financial markets. The seminal publication is Stiglitz and Weiss (1981).

problem disappear for the lender, as verification of a major event is easier than of moderate shocks. But when shocks are not severe, influential farmer lobbies may collude to extract debt rescheduling or debt forgiveness from their lenders, often successfully enlisting politicians in the cause. The resulting need for a re-capitalization of agricultural credit institutions will then typically be transferred to the national budget. Failing agricultural, or rural, financial institutions have been notorious for aggravating macro-economic difficulties (Yaron, 1992).

Crop insurance and the problems of covariance and moral hazard

Crop insurance programs have long been advocated to overcome the riskiness of lending in rural areas, usually in the form of insuring loans or loan service payments. However, crop insurance can only play a limited role in reducing the agricultural risk facing farmers, because crop insurance programs face the same problems that agricultural credit faces: heterogeneity, asymmetric information, covariant risks, and moral hazard. Transferring the risk of agricultural credit to an insurer who faces the same problems as the lender therefore cannot be the solution. The documented failure or huge subsidy dependence of crop insurance all over the world is ample testimony to its inability to overcome these problems (Hazell, Pomareda and Valdéz, 1986).

An alternative version of crop insurance often advocated is rainfall-based insurance. Here, payouts are automatically linked to rainfall deficits in a particular area, rather than on crop yields. Unfortunately, the correlation between rainfall and output, or rainfall and price risk is rarely strong, even at the village level, and much less so at more aggregate levels, where the necessary rainfall data are usually available. A rainfall-based crop insurance scheme will only work in cases of massive droughts or floods, when moral hazard problems are insignificant anyway.

Difficulty of mortgage-based lending

Mortgaging of farmer or group assets is a well-known solution to improve repayment incentives. But the international evidence shows that there is little agricultural term credit in developing countries based on mortgaging individual farms. The reason for the dearth of mortgage-based agricultural lending may simply be related to low population density and the absence of private and tradable property rights in land. However, mortgaging is very often also absent in areas with high population densities and private property regimes, or in areas where common

property allows for individual rights to specific plots to become very secure and tradable, at least inside communities. In these cases, the absence of mortgaging is because the community, or the society at large, does not allow a financial institution or moneylender to foreclose on someone's land or other agricultural property. This may be because land is an important social safety net, with no alternative social insurance mechanisms available. But even in developed countries, where such mechanisms are available, farmer bailouts to prevent foreclosure are not uncommon.

Obviously, if foreclosure is impossible, land loses its attractiveness as collateral. Alternatives exist in the form of buildings and tree crops, but since these are permanently fixed to the land they are often equally unsuitable to function as collateral. And collateral alternatives that are not fixed to the land will of course miss the important collateral quality of immobility.

Theoretically, a group could offer its land, held under common property, as collateral. In practice, this runs into even greater social resistance. Who would seize the land and homes of an entire poor community, forcing the group to resettle? Hence, in many cases, mortgaging can only be used as a repayment incentive within the community, and only when land is both scarce and tradable within the community.

Generic solutions

What would be the generic principles involved in solving the above problems? What would be the operating guidelines for a hypothetical financial institution, expected to be reasonably successful in delivering agricultural term credit to small farmers in Africa?

Low demand for credit

The solution is to focus on areas of high population density, periurban areas, and areas in close proximity to markets or with good links to markets. In these areas, the profitability of intensive agricultural production based on purchased inputs will be relatively high. This will induce an effective demand for agricultural credit.

Heterogeneity and moral hazard

Because a group knows its members better than anyone else, group, rather than individual, lending or joint liability has been part of many micro-finance systems and credit cooperatives

to reduce the high levels of idiosyncratic risk associated with heterogeneity and to overcome moral hazard at the local or community level (Ghatak and Guinnane, 1999). In micro-finance institutions, group lending is most often combined with other incentives, such as increasing loan amounts over time, short maturities, and the threat to cut off any future lending in the case of default, regular repayment schedules and regular forced savings. Gine (2004) reviews the empirical evidence on the impact of these practices, which shows that they significantly increase repayment rates, and therefore are an effective means to overcome problems of heterogeneity and moral hazard at the local level. However, the empirical studies reviewed by Gine (2004) still differ on whether these practices increase borrower welfare and productivity.

Group credit also reduces transactions costs for the lender, because the group consists of village insiders who have a lot of information already. In addition, they will “subsidize” transactions costs by volunteering their own time, labor and resources to collect additional information, define agreements and enforce contracts. The concept of group credit implies that the group will be jointly liable for the credit of each and all of its members. At the group’s discretion, individual repayment schedules can be flexible, matching individual cash flows, and various methods of enforcing compliance can be used, e.g., holding periodic meetings frequently enough to collect even very frequent individual repayments. Borrowers should be allowed to choose different repayment schedules, and to switch among them. As mentioned above, group lending cannot, however, insure the group against covariant risk, and other means to do so are discussed below.

But moral hazard also arises at other than the local level. Minimizing opportunistic behavior could in principle be achieved by a combination of the principles of subsidiarity and incentive compatibility at each of the levels where it arises. Moral hazard must be solved at the level with the best information (subsidiarity), and the agents in charge of enforcing repayment and monitoring shocks must face the appropriate incentives (incentive compatibility).

As mentioned above, financial institutions are often subject to political pressures to reschedule or forgive agricultural debts. The solution therefore also needs to ensure that the institutions are isolated from the opportunistic behavior described above, as well as the state.

Seasonality

Client diversification, linking the credit program to clients with different cash flow profiles, can reduce the liquidity management problems stemming from seasonality. A financial institution dealing with agricultural credit will need to be part of a wider network, and include deposits from, and loans to, the rural non-farm sector. Seasonality problems will be even further reduced by including the urban sector. Linkages to urban and foreign capital markets are also essential for the profitable placement of idle deposits, and to borrow added liquidity at low cost. Successful cooperative agricultural finance institutions in the developed world, such as the RABO Bank of the Netherlands, and Crédit Agricole in France, all have more urban than rural business.

Covariant risks

In addition to dealing effectively with seasonality, client diversification of the types just described also assist in insuring against covariant risks. But client diversification is usually not enough, and some form of insurance will be needed. It is important to bear in mind that covariant risk arises at three levels, and solutions to insure it are needed for each of these levels: (i) one, two, or three villages experience a local shock; (ii) one, or a few districts experience a district shock; and (iii) large parts of the country experience a national shock.

A proposed institution

The above generic solutions to generic problems can be translated into the design of a hypothetical financial institution, the “Community Trust”, which could be expected to overcome the set of problems identified above and therefore be successful in providing agricultural credit to small farmers. The Community Trust design also reflects lessons from the experience of formal and informal savings and credit institutions around the world and in Sub-Saharan Africa. Suggestions are made to adapt the idea of the “Community Trust” to particular local situations.

The Community Trust entails setting up two separate financial organizations – the medium-term credit window (the Community Mortgage Bank), and the credit insurance window (the Reserve Funds). These could be separate organizations, or two units within the same organization. Most likely they would be set up as second tier institutions, using existing finance and micro-finance institutions to retail their products. This dual set up is not only derived from a theoretical perspective, but it is in fact commonly

found in very popular indigenous savings and loan institutions, the ROSCAs, which have a successful track record in mobilizing savings and extending medium-term credit.

The Community Trust will operate without any explicit or implicit guarantees from the state for deposits or loans. This will be straightforward with respect to explicit guarantees, but much more difficult with respect to implicit guarantees. To reduce expectations of an implicit guarantee, the institution will need to build up a track record free of “bail outs”, or develop efficient bankruptcy rules.

Credit insurance – the reserve funds

Only farmers are likely to have the information enabling them to judge whether other farmers face a real calamity or are pretending to do so. The first organizational principle therefore is “peer review”. This puts other farmers and villagers in charge of enforcing repayment and judging whether a calamity has occurred which merits using insurance and reserves. To provide the peer reviewers with incentives compatible to making the correct call, they should be the owners of the insurance and reserve system. The institution is composed of Reserve Funds operating at the various geographic levels to insure the risks faced by the medium-term credit organizations. It will operate as a hierarchy of geographic levels, and will also need to be re-insured internationally for national shocks. In our hypothetical example, four insurance funds are set up and operate at three levels. These are (i) the Community Reserve Fund for individual, idiosyncratic shocks; (ii) the District or Regional Reserve Fund for local covariant shocks; (iii) a National Reserve Fund for district co-variant shocks; and (iv) international re-insurance for national co-variant shocks.

Community Reserve Fund

A community association owns and administers this fund to minimize the transactions costs. The fund is established from members’ own, obligatory savings, and external start-up funds, which can be in the form of concessionary loans or grants. The Reserve Fund insures the repayment of a credit for a person who, through no fault of her own, faces repayment difficulties. Each member taking out a loan is obliged to buy the local loan insurance⁸. The decision to use the Reserve Fund is taken by the community. The accumulated excess reserves will lead to rebates on the insurance premium. The fact that the community

owns the fund means that the right incentives exist to use the fund sparingly, because this will translate into lower insurance premiums. A community reserve fund can also be combined with the other practices common in microfinance institutions discussed above, which have been shown to increase repayment rates, and it could collaborate with other institutions or programs which provide improved financial savings opportunities to rural dwellers.

District Reserve Fund

A regional or district association of the farmers’ organizations or village banks of the district owns and manages this fund. The fund insures the local village banks against local shocks. Association members decide when to cover arrears of one or several community banks. The accumulated excess reserves lead to rebates on the insurance premium.

National Reserve Fund

This fund is owned by farmers’ organizations to cover shocks in one or several districts. Lenders providing loans charge an insurance premium for national shocks to their borrowers, which is transferred to the fund. Low use of the insurance fund leads to rebates on the insurance premium.

International reinsurance

To insure against national shocks, the National Reserve Fund should be able to reinsure itself internationally. A variant of a crop or rainfall insurance could be applied, as well as price insurance via forward transactions in the commodity markets. Note that international reinsurance will only be required to address the problem of national shocks, not problems at lower levels. International reinsurance should be possible, because shocks affecting entire provinces or the nation as a whole are more easily verified by outsiders than individual, local or district level shocks, and because such large shocks lead to economies of scale in information gathering and claims settlement.

Initial and sustainable financing of the Reserve Funds

Members’ own insurance premiums, or forced savings, are the main source of funding for the Reserve Funds. An external institution could provide a small grant, or concessionary loan, to assist in starting up each of the funds. IDA grants could be used as well, but IDA loans should only be used if they can be made without a government guarantee, to avoid the moral hazard mentioned above.

⁸In the ROSCA's found commonly in Cameroon, this reserve fund is called the “trouble bank”, and it serves to collateralize the medium term loans given out (van den Brink and Chavas, 1997).

To sustain the reserve funds, a mandatory loan insurance premium is charged to the term borrowers. For instance, the village bank charges 14% for a loan, but the borrower also has to pay, say, 2% for each of the three reserve funds (local, regional and national), and for the international reinsurance for a total interest rate of 20%. Incentives are compatible in this set-up to manage the various reserve funds carefully. Member associations themselves, i.e., those with the best information about members' behavior, own and are in charge of managing the funds. Community and district reserve funds are owned and managed by farmers in the same community or district. Therefore, incentive dilution and information problems are minimized. Financial incentives will be such that high insurance pay-out rates will lead to high insurance premiums, and therefore a high final interest rate, whereas low pay-out rates will lead to premium rebates and a low final interest rate.

Insurance of interest payments only

Flexible loan term structures can help reduce the cost of insurance. To minimize the insurance premium for the reserve funds, these could insure only the interest, not the principal of the loan. Payouts from the insurance fund during one year would result in a lengthening of the mortgage term by one year. If the risk of an idiosyncratic or covariant shocks is one year in four, that would add on average 1.25 years to the term of a five year loan.

Medium-term credit – the community mortgage bank

We use the example of an institution based on mortgaging of land, but in principle other collateral alternatives could form the basis of the institution. However, some type of collateral will in general be needed to make the credit market work, given imperfect information. If we assume for the moment that such collateral alternatives to land mortgages are absent, the setting in which the mortgage bank will operate will need to have some form of a land market, otherwise a credit market failure will be likely (Binswanger and McIntire, 1987).

Recall that for mortgage-based lending to work, a number of conditions need to be met. Land needs to be scarce, so that it has real value. Secure, individual property rights need to exist that are inheritable and freely transferable, at least within the community. Note that this need not be private ownership based on title deeds. Secure, inheritable and transferable usufruct

rights will do as well. In many traditional rights systems, and increasingly in formal land tenure systems (e.g., the Mexican Ejido) the usufruct rights have become tradable within the community, with the consent of the community, and such systems can be generalized to other countries. Similar property rights often exist for in informal settlements in urban and periurban areas.

Therefore the mortgage bank need not be confined to rural areas, and the necessary links with urban and periurban areas with low covariance of income can be established. Mortgaging of individual land rights will also require some form of community driven land administration and land registration. The type of loans which the Mortgage Bank would target are for lumpy investments which would require several years to pay back, given the particular repayment capacity of the borrower. Poor people normally use sweat equity to build their homes over several years, financing materials and skilled labor as and when they can afford them, given their meager cash flows. The loans from the Mortgage Bank would allow them to accelerate the process. Investment in tree plantations or small-scale irrigation infrastructure would be other typical examples of loans. Repayment periods could be in the order of 2 to 5 years.

Even with usufruct mortgages, the main repayment incentive will consist of the blacklisting of individuals in arrears. The individual in question will be excluded from new loans, and repayment would be maintained following a standard and often repeated game argument in which the benefits of continued membership of the Mortgage Bank exceed the one-off benefit of loan default (Abreu, 1988).

However, shocks will occur, and some individuals will fall into arrears. To cope with this eventuality, an additional system can be used to minimize the use of foreclosure on mortgages first formally pioneered in a production credit program in the Dominican Republic (Strasma, 1995). The community first arranges for a temporary loan of your land (or part of your land) to another community member or agreeable outsider. The new "tenant" will clear the arrears, farm the land for one year, and pay the next installment.

If the land is exceptionally valuable, the tenant may also pay some residual rent. The details of this system can be adapted to specific settings. In fact, private moneylenders in certain parts of Africa already operate a variant of this system: informal

adjudication of land rights allows them to farm land that has been pledged until the loans are repaid. The principle is that the “mortgaged” land is first being lent to somebody who can use it. The borrowing member pledges the usufruct of his or her land for a period commensurate with the value of the loan payments. Borrowers do not lose their property rights, only the temporary usufruct. The usufruct mortgage is the formal mortgage of the usufruct right over the land.

Even then, there will of course be cases when a borrower will not recover his or her ability to resume payments of the loan, and default becomes unavoidable. In that case, the community should be willing to enforce the usufruct mortgage, and force the individual in arrears to sell the rights in the land to another community member or to an outsider.

These decisions are entirely up to the community, which can make its own policies and exceptions. For instance, if a member dies, the community may want the spouse and children to be protected from foreclosure. It could finance this type of exception by using part of the Reserve Fund, or by arranging for a long-term lease of the land until the children can resume cultivation. In all events, the community needs to make clear and transparent rules on how to handle foreclosure and exceptions – “bankruptcy rules”.

As with any other financial institution, community-based mortgage banks could choose to lend out of their own members’ deposits, or to borrow funds for “on-lending” from the banking system at the district or national level. If a Mortgage Bank defaults, it would be blacklisted. It would no longer have access to new loans and would lose its ability to borrow further in the district or national financial system.

Capital and governance structure of the National Reserve Fund and National Mortgage Bank

Farmers will need a blocking minority in the shareholding structure of the national institutions to oblige these institutions to do business with them. Other shareholders should include the urban poor, or associations representing them, and various types of other domestic investors. A credible foreign investor would also be necessary and should have a blocking minority to insulate against political interference at the national level. The state should be isolated from any contingent liability arising from difficulties of the insurance and mortgage bank. Grants or concessionary loans would need to be sourced to provide the initial paid-in capital for the farmers and the urban poor.

A national mortgage bank could use existing micro-finance institutions to on-lend and administer the insurance policies, thereby saving on transactions costs. The micro-finance institutions would benefit by having attractive new products.

Summary and conclusion

We started by listing the fundamental problems and generic solutions of the demand and supply of agricultural credit in Sub-Saharan Africa: low demand for credit, heterogeneity, seasonality, covariant risks, moral hazard, inability of crop insurance to solve the problems of covariance and moral hazard, and the difficulty of mortgage-based lending.

We attempted to solve each of these problems in turn, in the process designing a hypothetical financial system composed, at each geographic level (local, district and national), of a medium-term credit window – the Community Mortgage Bank – and a credit insurance window – the Reserve Fund. The National Reserve Fund would be re-insured internationally.

The system would focus on high intensity areas and areas with good market linkages to avoid a lack of effective demand for credit. Heterogeneity would be addressed by using the concept of joint liability under group lending with flexible repayment schedules, and a Community Reserve Fund to deal with individual idiosyncratic risk. To cope with seasonality, the system would include links to non-farm and urban sectors and financial markets (rural non-farm, urban and international).

The potential impacts of covariant risks and moral hazard would be minimized by operating a system of Reserve Funds, which is mainly financed from members’ own obligatory loan insurance premiums. These insurance premiums partially collateralize the lending and also provide a savings function. At each geographic level, the relevant Reserve Fund would be owned and managed by farmers themselves. The loans provided by the Community Mortgage Bank would have flexible term structures so that only the interest needs to be insured. The loans would be based on a particular form of mortgaging, under which only the usufruct right would be mortgaged, instead of the full private property right. When a member has loan repayment difficulties, he or she will be obliged to temporarily lease out the usufruct right of the land, until his or her repayment capacity has been restored. The sale of the individual farm to other members of the community, or to outsiders with the consent of the community, would only take place after several years of temporary leases.

We understand that the proposed financial system attempts to solve a problem that has bedeviled the agricultural development of Sub-Saharan Africa, and many other developing areas, for decades. A dose of healthy skepticism by the reader is therefore warranted. But we believe the search for a solution needs to continue⁹. Each characteristic of the proposed financial institution is desirable from a theoretical perspective, and many of them have individually also proven to be empirically robust. What is new in the proposed solution is the combination of these characteristics in an internationally consistent system. We believe the proposed approach can work. We call upon the development community to invest resources in its piloting.

Definitions

Asymmetric information: the two parties to a contract do not have the same information.

Idiosyncratic risk: risk that affects only one individual or family, e.g., a broken leg, a fire in the house.

Incentive compatibility: a situation in which economic actors have all the information they need and face the right incentives to optimally solve a problem.

Moral hazard: situation under which one party could exhibit opportunistic behavior because of asymmetric information problem.

Subsidiarity: principle under which decisions, functions, and public goods production take place at the lowest possible level. Only when a lower level cannot perform a function should it be passed to a higher level.

Systemic shocks or co-variant risks: risks that exhibit a positive correlation with each other. Examples are droughts, floods, animal and crop epidemics, locusts, and collapses in prices.

Transactions costs: costs of information gathering, contracting and enforcement of contracts.

References

- Abreu, D. 1988. "On the Theory of Infinitely Repeated Games with Discounting." *Econometrica* 56(2): 383-396.
- Adams, D.W. and A.F. Delbert. 1994. *Finance Informelle dans les Pays en Développement*. Lyon, France: Presses Universitaires de Lyon.
- Besley, T. 1994. "How Do Market Failures Justify Interventions in Rural Credit Markets?" *The World Bank Research Observer* 9 (1, January): 27-48.
- Binswanger, H. and J. McIntire. 1987. "Behavioral and Material Determinants of Production Relations in Land-abundant Tropical Agriculture." *Economic Development and Cultural Change* 36 (1): 73-99.
- Binswanger, H. and M.R. Rosenzweig. 1986. "Behavioural and Material Determinants of Production: Relations in Agriculture." *The Journal of Development Studies*, Vol. 22, No. 3 (April): 503-539. Also available in Japanese.
- Binswanger, H., R.S. Khandker and M. Rosenzweig. 1993. "How Infrastructure and Financial Institutions Affect Agricultural Output and Investment in India." *Journal of Development Economics* 41: 337-366.
- Chavas, J-P., P.M. Kristjanson and P. Matlon. 1991. "On the Role of Information in Decision-Making: The Case of Sorghum Yield In Burkina Faso." *Journal of Development Economics* 35: 261-280.
- Ghatak, M. and T. Guinnane. 1999. "The Economics of Lending with Joint Liability: Theory and Practice." *Journal of Development Economics* 60: 195-228.
- Gine, X. 2004. "Literature Review on Access to Finance for SME and Low-income Households." World Bank mimeo.
- Hazell, P., C. Pomareda and A. Valdés. 1986. *Crop Insurance for Agricultural Development: Issues and Experience*. Baltimore: The Johns Hopkins University Press.
- Khandker, S.R. 1996. "Grameen Bank: Impact, Costs and Program Sustainability." *Asian Development Review* 14 (1): 97-130.
- Mathieu, N. 1998. *Financial Sector Reform: A Review of World Bank Assistance*. Operations Evaluation Department, The World Bank. Washington, DC.
- Pingali, P., Y. Bigot and H. Binswanger. 1987. *Agricultural Mechanization and the Evolution of Farming Systems in Sub-Saharan Africa*. The Johns Hopkins University Press. Baltimore, Maryland.
- Operations Evaluation Department. 1994. *Mexico: Ninth Agricultural Credit Project Project Completion Report*. Report No. 13840. The World Bank. Washington, DC.
- Sadoulet, E., and A. de Janvry. 1995. *Quantitative Development Policy Analysis*. The Johns Hopkins University Press. Baltimore, Maryland.

⁹Yaron (2004) has already produced a skeptical, yet helpful review of our proposal. He particularly highlights the requirement for community cohesion and strong honest leadership, the risk of elite domination of the proposed scheme at the community level, and the complexities of understanding and managing co-variant risks and the respective reserve funds at the different levels as factors that might limit the applicability and success of our proposed approach. He therefore advocates a cautious approach to testing at relatively small scales.

Stiglitz, J. and A. Weiss. 1981. "Credit Rationing in Markets with Imperfect Information." *American Economic Review* 71: 393-409.

Strasma, J. 1995. "Garantías Justas para el Crédito Rural Justo y Sostenible." *Revista Encuentro*, Universidad Centro Americana. Managua, Nicaragua.

Van den Brink, R. and J-P. Chavas. 1997. "The Microeconomics of an Indigenous African Institution: The Rotating Savings and Credit Association." *Economic Development and Cultural Change* 45 (4): 745-772.

Von Pischke, J.D., D.W. Adams and G. Donald. 1983. *Rural Financial Markets in Developing Countries: Their Use and Abuse*. The Johns Hopkins University Press for the Economic Development Institute of the World Bank. Baltimore, Maryland and London, England.

Yaron, J. 1992. "Successful Rural Finance Institutions." *World Bank Discussion Paper* No. 150. The World Bank. Washington, DC.

Yaron, J. 2004. *Agricultural Credit and Rural Finance in SSA Countries: The Prospects for Community Driven Mortgage Lending*. World Bank mimeo.

Yaron, J., McDonald Benjamin and S. Charitonenko. 1998. "Promoting Efficient Rural Financial Intermediation." *The World Bank Research Observer* Vol. 13, Issue 2: 147-170.



Climate risk, information and market participation for African farmers

James Hansen^{1,2}, Stephen Zebiak¹, Walter Baethgen¹, Amor Ines and Daniel Osgood¹

Abstract

Through its impact on production and price volatility, influence on farmer management, disincentive effect on market institutions and role in dynamic poverty traps, climate-related risk contributes to the widespread failure of markets to benefit smallholder farmers in Sub-Saharan Africa. It impedes farmers' participation in markets by reducing both demand for, and supply of, rural market services. We discuss several promising opportunities to improve management of climate risk within the agricultural sector of Africa – use of seasonal forecasts for adaptive management and to coordinate input supply, weather index insurance, food crisis management, and trade to manage price volatility – that depend on or benefit from climate information. These interventions have not been fully exploited, in part because of gaps in existing climate information products and services. A common climate-informed crop monitoring and forecasting platform, which provides continuously updated, probabilistic information about climate impacts at a suitable spatial resolution, could enhance the value of climate information for multiple interventions. In the context of such a system, we discuss the rationale for translating climate information into agricultural production terms, the relevance of the lead-time/accuracy tradeoff, opportunities to improve lead-time and accuracy, and opportunities to address data scarcity. If value-added climate information is to contribute significantly to efforts to improve the livelihoods of African farmers, we argue that gaps in climate data, information services, delivery mechanisms, early response mechanisms and coordination must be addressed in parallel.

Introduction

Climate-related risk is one of several factors that contribute to chronic poverty, constrain farmers' participation in markets, and impede progress toward a profitable agricultural sector, particularly in the dryer (i.e., dry sub-humid to arid) rainfed regions of Sub-Saharan Africa (SSA). The Comprehensive Africa Agriculture Development Program (CAADP) (NEPAD, 2002), identifies "vagaries of climate and consequent risk that deters investment" as one of six key challenges to achieving a productive and profitable agricultural sector across Africa. Efforts to make markets work for smallholder farmers in SSA

should consider the range of opportunities to manage climate-related risk. Several opportunities to better manage climate-related risk and reduce its negative consequences require or benefit from climate information. Progress is constrained, in part, by a substantial gap between the current supply of climate information products and services, and the needs of development at the scale of the MDGs (IRI, 2006). In this paper we: (i) survey the ways that climate risk impacts the livelihoods and market participation of African smallholder farmers, (ii) discuss several promising interventions that use climate information to reduce the negative impacts of climate risk, and (iii) explore opportunities to increase the utility of climate information for risk management within smallholder agriculture in SSA.

Climate risk, rural livelihoods and market participation

Climate-related risk impedes farmers' participation in markets both by reducing demand at the farm household level and by affecting supply through impacts on market development (Kelly et al., 2003; Poulton et al., 2006a). Although climate risk impacts the agricultural sector at multiple scales, available evidence is better developed at macro- (i.e., national economies) and micro- (i.e., farm household) scales than at the meso-scale of agricultural market value chains. At the macro-scale, Brown et al. (2008) found that drought risk has a detectable negative impact on GDP growth in about a third of the countries in SSA. The World Bank (2006) estimated that climate variability reduces Ethiopia's economic growth by one third, and that a single drought event reduced growth by 10% during the subsequent 12-year period. Current understanding of the mechanisms by which climate variability impacts rural livelihoods and market participation is incomplete particularly at the meso-scale, yet provides some insights into opportunities to intervene.

Climate impacts on production and prices

In the tropics, year-to-year climate variability affects crop production primarily by driving the supply of soil moisture, although temperature fluctuations can be important where either high or low temperatures are near the limits of crop tolerance. Because biological response is nonlinear and generally concave over some range of environmental variability, climate variability tends to reduce average yields.

¹International Research Institute for Climate and Society, PO Box 1000, 91 Route 9W, Palisades, NY 10930, USA.

²Corresponding author (jhansen@iri.columbia.edu)

Climate-driven production fluctuations contribute substantially to volatility of food prices where remoteness, the nature of the commodity, transportation infrastructure, stage of market development or policy limit integration with global markets. Poorer, landlocked, drought-prone countries are particularly susceptible to climate-driven staple crop price fluctuations (Byerlee et al., 2006). In SSA, high transport costs and poor market infrastructure contribute to the sensitivity of staple crop prices to climate (Zimmerman and Carter, 2003). Price volatility tends to be generally greater for horticultural crops that cannot be economically stored or transported long distances.

Excessive food price volatility affects net sellers and net buyers differently (Poulton et al., 2006b). For net sellers, it is a disincentive to invest in intensified production of staple crops. On the positive side, the tendency of crop yields and prices to move in opposite directions tends to buffer the incomes of net sellers. However, it exacerbates food insecurity for poor net buyers – the majority of farmers in SSA – and encourages them to allocate scarce resources to staple crop production for household consumption, instead of higher-value, market-oriented commodities that might enable them to escape poverty (Fafchamps, 1992). Poulton et al. (2006b) argue that price volatility and its impact on transaction costs are a disincentive to development of the entire agricultural supply chain.

Climate impacts on farm households

Ex-post impacts of climate shocks on assets - Climate-related disasters impact poor countries, and the relatively poor within countries, disproportionately (Carter et al., 2007; Easterly, 2001; Gaiha and Thapa, 2006). A severe, uninsured climate shock, such as a drought or flood, can have long-term livelihood consequences through direct damage to crop and livestock productivity, infrastructure, the few productive assets of the poor, and sometimes health. Vulnerable households employ a range of strategies to cope with the resulting crisis, including liquidating productive assets, defaulting on loans, migration, withdrawing children from school to work on farm or tend livestock, severely reducing nutrient intake, and over-exploiting natural resources. Coping strategies that allow households to weather a crisis in the short term often sacrifice capacity to build a better life in the future (Alderman et al., 2006; Carter and Barrett, 2006; Carter et al., 2007; Dercon, 2004; Dercon and Hoddinott, 2005; Hoddinott, 2006; McPeak and Barrett, 2001).

Ex-ante impacts of climatic uncertainty on management

The uncertainty associated with climate variability creates a moving target for management that reduces efficiency of input use and hence profitability. Under rainfed conditions, crop responsiveness to fertilizer (Christianson and Vlek, 1991; Pala et al., 1996) and planting density (Anderson, 1984; Myers and Foale, 1981), and hence optimal rates and profitability of production inputs (Hansen et al., 2009; Jones et al., 2000; Piha, 1993), vary considerably from year to year as a function of water supply. Management that is optimal for average climatic conditions can be far from optimal for growing season weather in most years (e.g., Figure 1). Estimates based on agronomic models, and assuming expected profit maximization (Hansen et al., 2009; Jones et al., 2000; Royce et al., 2001), show that this “moving target effect,” in the absence of risk aversion, reduces the efficiency of input use and reduces income substantially, e.g.,

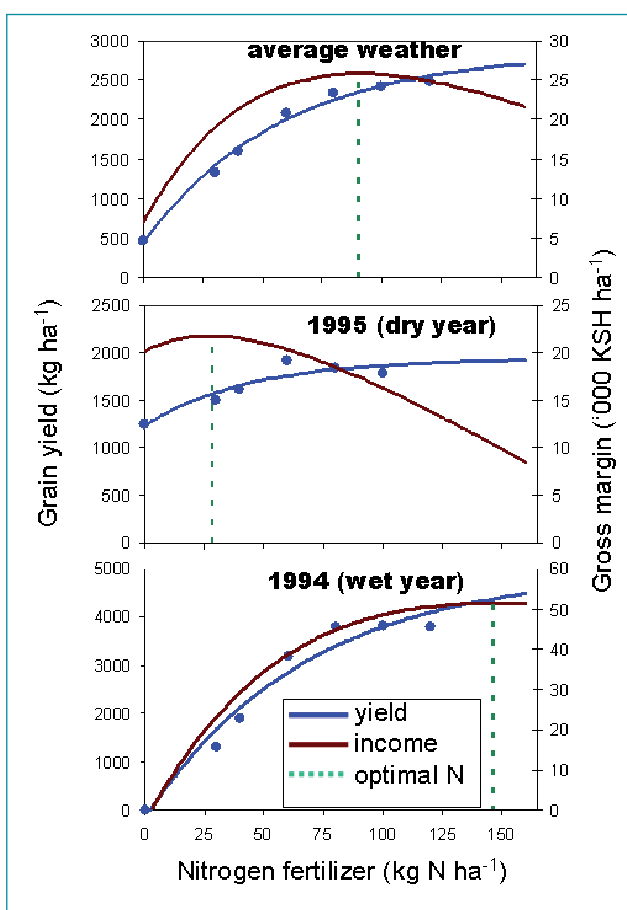


Figure 1. Profit-maximizing nitrogen fertilizer levels for all years and an individual dry and wet year, Katumani, Kenya. Assumptions and methods are described in Hansen et al. (2009).

Table 1. Impact of uncertainty and risk aversion on optimal maize management and resulting yields and returns, Katumani, Kenya. Simulation methodology and assumptions are described in (Hansen et al., 2009).

	Gross margin	Yield	Fertilizer	Planting density
Scenario	KSH ha-1	Mg ha-1	kg N ha-1	plants m-2
Perfect information	23,006	3.10	56	3.9
Risk-neutrality ($r_p=0.0$)	13,851	2.34	50	3.5
Slight risk aversion ($r_p=0.5$)	13,357	2.24	47	3.1
Typical risk aversion ($r_p=1.0$)	12,343	2.03	40	2.2
Moderate risk aversion ($r_p=2.0$)	11,989	1.92	30	2.2
Strong risk aversion ($r_p=3.0$)	11,283	1.72	24	2.2

15-30% of the average gross value of production and 24-69% of the average gross margin for two semiarid locations in Kenya (Hansen et al., 2009; Table 1).

The tendency of smallholder farmers to be averse to risk leads to further loss of opportunity, beyond the moving target effect, in climatically favorable and even average years. To protect against the possibility of catastrophic loss, smallholder farmers employ a range of precautionary strategies that include selection of less risky but less profitable crops or cultivars, under-use or avoidance of inputs such as fertilizers, avoidance of credit, and shifting from productive to non-productive but more liquid assets as precautionary savings (Dercon, 1996; Fafchamps, 2003; Morduch, 1990; Paxon, 1992; Rose, 2001; Rosenzweig and Stark, 1989; Zimmerman and Carter, 2003). For the risk-averse smallholder farmer, climate-related risk appears to be a significant disincentive to investing in productive assets (Barrett et al., 2007; Fafchamps, 2003) and adopting improved technology (Barrett et al., 2004; Kebede, 1992; Marra et al., 2003).

The influence of climate risk on fertilizer use is a particular concern, given the strong link between widespread soil nutrient depletion and declining per-capita food production across SSA. A few studies (Dercon and Christiaensen, 2007; Simtowe, 2006) now provide empirical support for the belief that climate risk is a key obstacle to adequate fertilizer use in SSA. Binswanger and Sillers (1983) suggested that production risk might reduce fertilizer use by about 20%, based on limited evidence extrapolated from Asia and Latin America. However, Morris et al. (2007) argue that cereal production risk is considerably higher in many African countries and therefore leads to much greater reductions in rational fertilizer application rates under

plausible assumptions about risk aversion and cost of credit. To illustrate the potential impact of climate risk on fertilizer use and profitability, we extend a recent simulation study of the potential value seasonal rainfall forecasts for rainfed maize management under risk neutrality in semiarid Kenya (Hansen et al., 2009), assuming a plausible farm with 1.4 hectares available for market-oriented maize; and with US \$300 y-1 (KSH 30,326 y-1 based on the December 2004 exchange rate in Hansen et al., 2009) secure income from other sources, less fixed expenditures. These assumptions are well within ranges elicited from 40 farmers in the region, although we assume a less diversified farm than is typical. We identified management (among 11 fertilizer rates \times 4 planting densities) that maximizes expected utility of net annual farm income subject to the 1.4 ha area constraint, based on a constant partial risk aversion (rP) formulation. The large difference in returns based on perfect information and risk neutrality (Table 1) represents the cost of the “moving target effect” mentioned earlier. Under our assumptions, climate risk reduces fertilizer use by about one half for a strongly risk-averse farmer, with corresponding reduction in mean yield and gross margin.

Available evidence suggests that the cost of ex-ante risk management responses may be greater than the direct, ex-post impacts of shocks (Elbers et al., 2007), and is greatest for the relatively poor within a poor rural community (Rosenzweig and Binswanger, 1993; Zimmerman and Carter, 2003). The impact on demand for production inputs must have an adverse effect on incentives to develop input markets, but studies on the magnitude of impact on markets are lacking.

Climate impacts on market institutions

Farm-level climate impacts on demand for agricultural inputs and services and on the reliability of production can be expected to adversely affect market development. Risk also has more direct impacts on the incentives that agricultural market institutions face. Although risks related to policy (e.g., contract enforcement) and coordination seem to play a more significant role for market institutions than for individual farmers, market institutions still face considerable risk that is linked to climate.

Risk aversion appears to affect other actors within the agricultural sector beside farmers. Spatially correlated, catastrophic losses from climatic or other shocks can exceed the reserves of an insurer or lender, and lead to financial market failures in many low-income countries (Besley, 1995; Miranda and Glauber, 1997; Poulton et al., 2006a). The link between climate risk and rural market development is most apparent for financial services (i.e., credit, insurance). Where they exist, rural banks generally don't lend to smallholder rainfed farmers unless their risk is reduced, for example through collateral, or severe enforced penalties. The willingness of banks in Malawi to lend to smallholder farmers who hold rainfall index insurance (Hellmuth et al., 2009; Hess and Syroka, 2005) demonstrates institutional risk aversion. Climate-driven volatility of production and prices is likely to be a deterrent to rural market development more generally, although published evidence is sparse. Kelly et al. (2003) argue that efforts to develop agricultural input markets in SSA are most successful when they include policy mechanisms for controlling risk to suppliers.

If they are not targeted and managed well, the actions that governments and aid organizations take in response to climate shocks can have major impacts on incentives for private sector market development. An increasing, and sometimes overwhelming, majority of international assistance to Africa is devoted to disaster response (Abdulai et al., 2004; Barrett and Carter, 2001). In Ethiopia, for example, the USA spends US\$ 200-300 million per year on food aid and only US\$ 4 million per year on agricultural development according to Abdulai et al. (2004). Climate (primarily drought) and conflict account for the vast majority of humanitarian assistance. Abdulai et al., argued that humanitarian assistance, particularly in the form of food aid, can be a disincentive for governments to invest in agricultural research and development. Although food aid has had a mixed record, the evidence suggests that targeting

and management have improved and that incentive effects on market development are more often positive than negative (Abdulai et al., 2005; Barrett, 2002; Hoddinott, 2008). Kelly et al. (2003) argue that large-scale seed distribution programs, designed to speed recovery following drought-related food crises, have reduced incentives and increased the risks facing private sector input suppliers. Alternatives such as distribution of cash or vouchers redeemable for production inputs can avoid the problems and stimulate markets.

Climate risk and poverty traps

The failure of markets to benefit many smallholder farmers is not just a result of inadequate market development or infrastructure. More fundamentally, poor market participation reflects a syndrome of low-level equilibria, or poverty traps, characterized also by dominance of subsistence staple crop production, poor adoption of innovation, persistent food and livelihood insecurity and, at an aggregate scale, economic stagnation and often chronic dependence on humanitarian assistance (Barrett, 2005; Barrett, 2007). A dynamic poverty trap occurs when there is a critical threshold of household assets, below which individuals are unable to accumulate the necessary resources to escape poverty (Barrett, 2005; Carter and Barrett, 2006). Climate-related risk contributes to such poverty traps in at least three ways. First, through ex-post coping responses, severe or repeated climate shocks can push households to divest productive assets to a point below the poverty trap threshold. Second, ex-ante risk management strategies reduce the productivity and profitability of existing assets, and discourage accumulation of productive asset accumulation. Third, the tendency for risk tolerance to decrease with decreasing resource endowment (Pope and Just, 1991; Wik and Holden, 1998; Yesuf and Bluffstone, 2007) contributes to the higher opportunity cost of climate risk for the relatively poor, and hence to locally increasing marginal productivity – a precondition for the existence of multiple dynamic equilibria associated with a poverty trap (Carter and Barrett, 2006). Furthermore, constraints such as climate-related risk that impact institutions or governments operating at an aggregate scale can further constrain economic opportunities and hence reinforce poverty traps at the household level (Barrett and Swallow, 2006; Carter and Barrett, 2006).

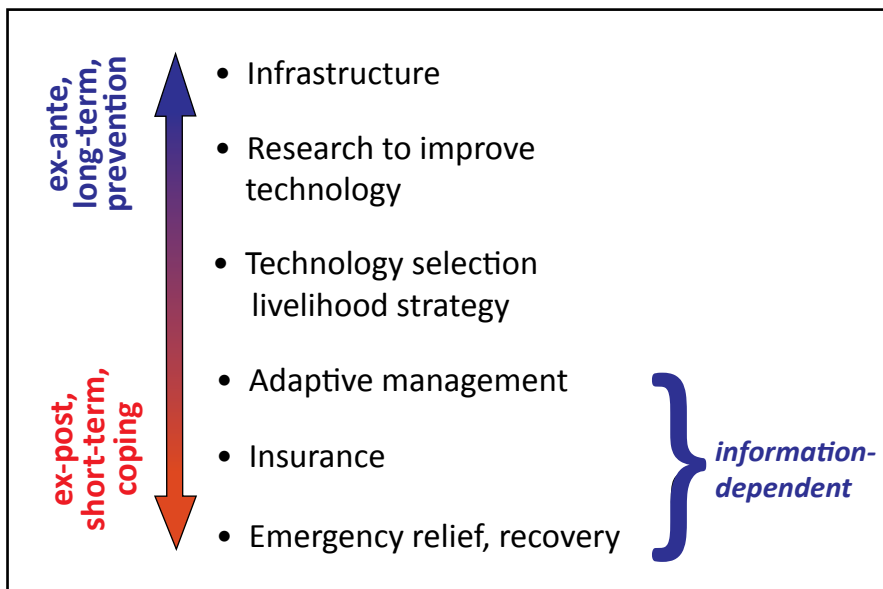
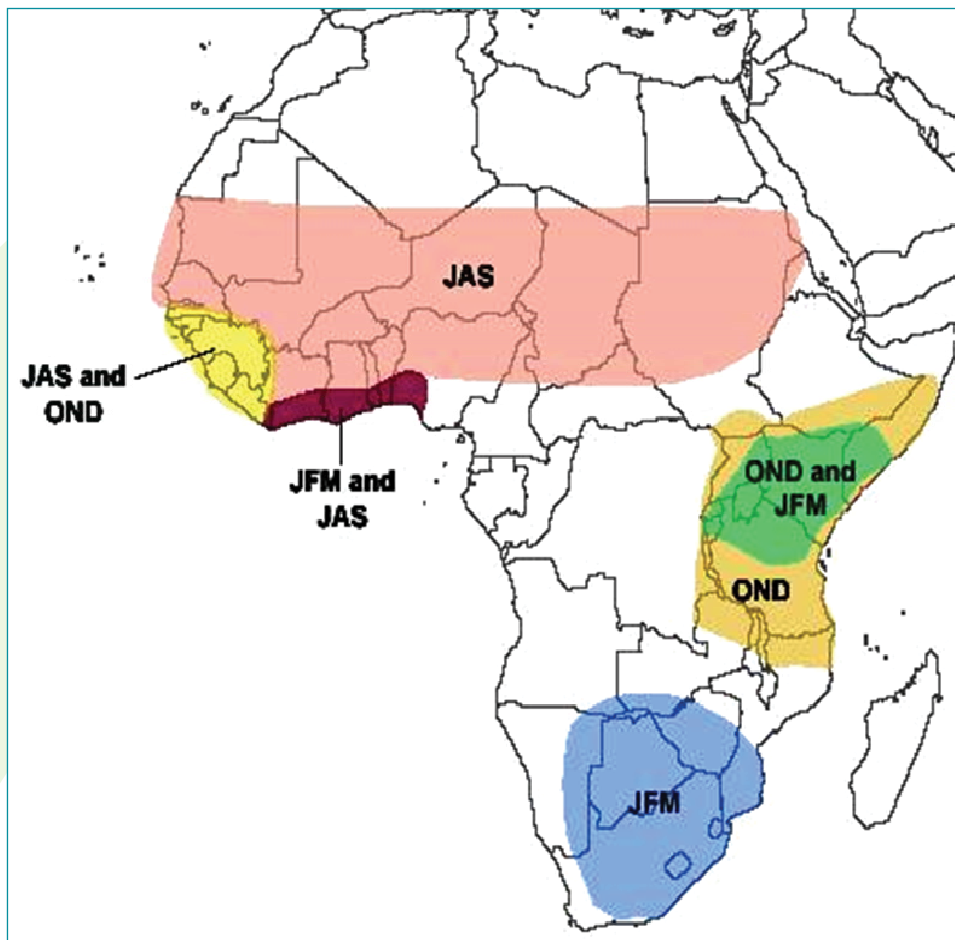


Figure 2. Examples of climate risk management interventions, ordered from ex-ante to ex-post.



Source: (IRI, 2006).

Figure 3. Regions and seasons in Africa with established predictability at a seasonal lead time. JAS = Jul-Sep, OND = Oct-Dec, JFM = Jan-Mar.

Opportunities to use information to manage risk

A wide range of technologies, management strategies and policies target climate-related risk. In terms of timing, they range from long-term investments that reduce vulnerability future shocks, to ex-post responses to climate shocks (Figure 2). We focus here on a few promising interventions that have implications for market participation for African farmers, and that involve use of climate information (historic records, monitoring and prediction).

Seasonal forecasts for adaptive management

Rainfall is predictable at a seasonal lead-time, in several agriculturally important regions and seasons in SSA (Figure 3), due to the interaction between the global atmosphere and the more slowly varying, underlying ocean and land surfaces. Significant predictability coincides with cropping seasons in the October-December “short rains” in East Africa (much of Kenya, eastern Uganda and northern Tanzania), Sudano-Sahelian West Africa, and in southern Africa up to southern Zambia. There is established but weaker predictability for the northern spring “long rains” in East Africa, and the northern winter in the coastal countries of West Africa.

Seasonal climate forecasts match the period between the many climate-sensitive decisions that must be made prior to planting, and harvest when outcomes of those decisions are realized. By reducing uncertainty about growing season conditions and the outcomes of management, skillful seasonal forecasts can, in principle, provide: opportunities to adopt improved technology, intensify production, replenish soil nutrients, invest in more profitable enterprises when climatic conditions are favorable or near average, and more effectively protect their families and farms against the long-term consequences of adverse extremes. Research with smallholder farmers in dryland locations in SSA demonstrates a high level of interest in forecast information and promising management responses (Hansen et al., 2007; Ngugi, 2002; Phillips, 2003; Roncoli et al., 2009; Tarhule and Lamb, 2003; Ziervogel, 2004). However, widespread communication failure, including limited and inequitable access, and a mismatch between farmers’ needs and the scale, content, format, or accuracy of available information products and services (Archer, 2003; Ingram et al., 2002; O’Brien et al., 2000; Phillips, 2003; Ziervogel, 2004) have limited the widespread use of seasonal forecasts among smallholder farmers. Regional climate outlook

forums (RCOFs) – the main mechanism for producing and disseminating seasonal climate forecasts in SSA – have given the agricultural sector little influence over the design of information products (at a cost to salience) and little ownership of the process (at a cost to legitimacy) (Cash et al., 2006; Hansen et al., 2007).

Constraints related to communication can feasibly be overcome. In terms of information products, research in several contexts (summarized in Hansen, 2002; Hansen, 2005) reveals that, if farmers are to use seasonal forecast information, it should (i) be downscaled and interpreted at a local scale; (ii) include information about within-season rainfall characteristics beyond seasonal total; (iii) express accuracy in transparent, probabilistic terms; and (iv) be interpreted in terms of agricultural impacts and management implications. Opportunities to improve delivery of climate forecast information are discussed later in this paper. Adoption rates and reported benefits have been reasonably high in pilot projects in Zimbabwe, southern India and Burkina Faso, where extended interaction between smallholder farmers and researchers reduced some of the communication barriers (Huda et al., 2004; Meinke et al., 2006; Patt et al., 2005; Roncoli et al., 2009).

Coordinating input and credit supply

Adaptive management in response to forecast information at the farm level requires a degree of coordination between demand and supply of production inputs such as fertilizers. Access to production inputs and credit constrains flexibility to intensify production generally, and particularly in response to forecast information (Ingram et al., 2002; Ngugi, 2002; Phillips, 2003; Phillips et al., 2001; Vogel, 2000), but the constraints might be reduced if forecast information allows market institutions to profitably coordinate supply of financing and key production inputs to demand by farmers. There is anecdotal evidence that seasonal climate forecasts already enter into the strategies of some input suppliers in SSA. According to Malusalila (2000), SeedCo – a seed producer and supplier operating in southern Africa – factors seasonal forecasts into their recommendations to farmers using different animals to represent the climatic sensitivity of groups of maize cultivars. Faida Seeds, which contracts private farmers throughout Kenya to produce maize and sunflower seed, has avoided climate-related losses since 1997 by participating in regional climate outlook forums, and by avoiding high-risk locations for seed multiplication, scaling down production, and emphasizing drought-tolerant cultivars when

forecasts show enhanced probability of drought conditions (C. Ng'ang'a, Managing Director, 2004, pers. comm.).

In principle, seasonal forecasts seem to offer opportunity to improve the availability and terms of credit on average, particularly in low-risk years when crops are more responsive to production inputs and risk of default is reduced. However, experience in Zimbabwe during the 1997-98 El Niño event is often cited as a basis for concern that forecasts will hurt farmers by making credit less available when adverse conditions are predicted but not realized (Glantz, 2001; Patt et al., 2007; Phillips et al., 2002). Interest in incorporating climate forecast information into the design of index insurance bundled with credit (see below) offers potential for a more robust approach to managing credit supply in response to climate information (Carrquiry and Osgood, 2008; Osgood et al., 2008).

While seasonal forecast information should be able to serve the needs of both farmers and input suppliers, input markets need longer lead-time than farmers if they are to adjust supply to changing demand in response to the information. Regional input supply chains should benefit from the greater predictability that exists at aggregate scales (Gong et al., 2003).

Weather index insurance

Recent innovations have resulted in a resurgence of interest in managing risk for smallholder rainfed agriculture through insurance and related financial risk transfer instruments. Basing insurance payouts on an objectively-measured index (e.g., rainfall amount, modeled water stress) that is correlated to loss instead of actual losses, overcomes problems with moral hazard, adverse selection and high transaction costs (needed to verify losses) that have generally made traditional indemnity-based insurance nonviable for smallholder farmers in developing countries (Barrett et al., 2007; Hess and Syroka, 2005; McCarthy, 2003; Skees and Enkh-Amgalan, 2002). Recent reviews by Barrett et al. (2007) and Hellmuth et al. (2009) summarize experiences and synthesize lessons from relevant index insurance applications.

Barrett et al. (2007) proposed a typology of index insurance applications to livelihood systems characterized by dynamic poverty traps. A productive safety net protects productive assets to prevent a currently non-poor household from falling

below a poverty trap threshold in the face of a shock. A pilot project targeting drought-related livestock mortality in northern Kenya (Mude, 2009) is a good example of a productive safety net application of index insurance. Second, what Barrett (2005) termed a "cargo net" seeks to facilitate exit from a poverty trap, e.g., by increasing productivity of a household's assets, removing entry barriers to profitable livelihood opportunities, or targeting the conditions that favor poverty traps. By addressing the risk aversion of lenders, a pilot index insurance project in Malawi provided smallholder rainfed farmers with access to a bundle of credit, production inputs for groundnut and maize, and the groundnut export market (Hess and Syroka, 2005; Osgood et al., 2007). Evidence suggests that strong demand for the insurance was associated with demand for credit, and not income or consumption smoothing (Gine and Yang, 2007)³.

Although there is a great deal of interest in rapidly scaling up this type of insurance application, it seems likely to be economically viable without subsidy only in contexts where risk is the only constraint to access to substantially more profitable livelihood opportunities. Third, a humanitarian safety net protects those in poverty from permanent destitution or health impacts in the face of shock. One of the first examples in SSA was a project of the World Food Program and Ethiopian government on rainfall insurance project designed to provide more timely access to funds to respond to emerging drought-related food crises. Contracts provided a payout directly to the national government for relief activities if an index of rainfall from a set of stations across the country falls below a specified threshold (Stayton and Hess, 2006; Wiseman and Hess, Submitted). This model has potential to greatly improve the timeliness of crisis response if donors would be willing to make the substantial shift from crisis reaction toward anticipatory payments in the form of premiums.

Index insurance applications need both good characterization of risk (i.e., the probability distribution of the index) in order to price the insurance properly, and the final index value at harvest. The effectiveness of index insurance as an alternative to indemnity insurance depends critically on having a viable index that is closely correlated to the targeted loss, which for most agricultural applications is crop or forage productions. Basis risk – the gap between an insured index and the risk it is meant to

³In their adoption study, Gine and Yang (2007) compared farmer take-up rates between two packages – the standard insurance and loan package, or a loan that was offered without insurance but secured by guaranteeing the loan repayment to the bank itself. They interpreted lower uptake of the package with insurance as evidence of lack of demand for insurance. In light of the overwhelming demand for the bundled package by farmers outside their study, who didn't have the option of borrowing without insurance, their results support the conclusion that farmers placed little value on the insurance beyond its intended role of providing access to credit (Hellmuth et al., 2009).

target – is regarded as the price paid for removing moral hazard, adverse selection and their resulting transaction costs as barriers to insuring vulnerable farmers against climate-related risk. Transparency and acceptability to clients and other stakeholders, vulnerability to manipulation, data requirements, and robustness and geographic coverage in regions with sparse data are also important considerations. In their review, Hellmuth et al. (2009) cite quality and quantity of meteorological and other data as a key constraint to scaling up index insurance applications for development and disaster management. Seasonal rainfall forecasts are sometimes seen as a threat to weather index insurance because they could threaten the financial viability of insurance by allowing farmers to purchase insurance only in years with enhanced drought risk and probability of payout (Hess and Syroka, 2005; Luo et al., 1994). Theoretical arguments and a numeric example from Malawi suggest that incorporating seasonal forecast information into the design of the contract could increase the livelihood benefits (Carriquiry and Osgood, 2008; Osgood et al., 2008), at least in the case where insurance is meant to support access to credit and intensified, market-oriented production.

Food crisis management

Assistance, particularly food aid, in response to a major food crisis can have complex impacts on farmers and on agricultural input and output markets (Abdulai et al., 2004; Barrett, 2002). Assistance that is targeted and managed well can protect the productive assets of vulnerable households, foster investment and intensification through its insurance effect, and under some circumstances, stimulate development of the value chain for agricultural products. Such assistance also carries the potential for creating large price fluctuations, disincentives to agricultural production and market development, and dependency, particularly if inadequate targeting or management allows leakage to unintended beneficiaries. Assistance must therefore be well targeted, both in terms of recipients and instruments (e.g., food aid distributed through markets or feeding centers, wash transfers, food for work) in order to avoid perverse incentives and foster long-term development.

To ensure that intervention is well targeted, institutional procedures typically require a high degree of certainty, in the form of verifiable market, consumption or health impacts, before initiating action. The verification-appeal-funding-delivery process that characterizes much of food security relief imposes a lag of at least several months between detection of a likely

shortfall and delivery of assistance to rural populations. The resulting delay greatly increases the humanitarian and persistent livelihood impacts of the crisis, and the cost of delivering food aid (Barrett et al., 2007; Broad and Agrawala, 2000; Haile, 2005). Early response is therefore essential to effective food crisis management, and the availability of early warning information is a precondition.

Several international organizations (e.g., FEWSNET, JRC, FAO, AGRHYMET, SADC/RRSU) and countries implement food security monitoring tools that include rainfall monitoring, satellite vegetation monitoring, and simple water balance-stress index models that incorporate historic and monitored weather data, to estimate food crop or forage production shortfalls in SSA in advance of harvest. Such early warning systems are among the best-developed applications of climate information in SSA, and are our starting point for discussing opportunities to enhance the utility of climate information for African agriculture.

Managing price fluctuations

Because of the adverse impacts of variability on commodity prices, the use of advance information to manage regional trade and storage for staple foods to stabilize prices is appealing, particularly in drought-prone, landlocked countries. The current policy environment in many countries greatly complicates the management of price volatility through international trade. Although structural reform policies have expanded the role of the private sector in international trade of agricultural commodities, their incomplete implementation has created coordination problems and ambiguity about the role of government vs. the private sector in many countries of SSA (Byerlee et al., 2006; Jayne et al., 2006). They have also generally reduced capacity to store grain to buffer prices. On the other hand, sub-regional economic communities (IGAD, ECOWAS, SADC) are reducing the political obstacles to intra-regional trade, and provide a mechanism to coordinate trade regionally.

Because of the lead time involved in international trade, the use of forecasts several months before harvest can be expected to improve the management of trade and storage generally (Arndt et al., 2003; Chen et al., 2008; Hallstrom, 2004; Hill et al., 2004). Economic equilibrium modeling in Mozambique suggests considerable potential aggregate benefits of market applications of climate forecasts (Arndt and Bacou, 2000; Arndt et al., 2003). Spatial equilibrium modeling of the global rice market shows that the impacts of ENSO events on producer and consumer welfare

can be reduced substantially by removing trade barriers and investing in storage capacity (Chen et al., 2008). Unfortunately, the literature seems to offer little direct guidance on the use of climate or production forecasts to manage agricultural trade and grain storage in SSA.

Value-added climate information for agriculture

Adaptive management of input supply and use, index-based crop and livestock insurance, managing intra-regional trade, and food crisis early warning and response share a common need for the best possible estimates of weather impacts on crop or forage production. They differ primarily in the timing of key actions and hence the lead-time of information required. A common climate-informed crop monitoring and forecasting platform, which provides continuously updated, probabilistic information about climate impacts at a suitable spatial resolution, could serve these multiple applications (Figure 4). The discussion that follows is meant to illustrate possible avenues for enhancing the utility of climate information products for a range of risk management applications in the context of smallholder agriculture in SSA.

Translating climate information into agricultural production terms

To be useful, raw climate information must be translated into impacts and management implications within the system being managed, whether through quantitative methods or through

a subjective process. Crop production is a function of dynamic, nonlinear interactions between weather, soil water and nutrient dynamics, management, and the physiology of the crop. The same amount of rainfall will have different impacts on the crop growth and final yield, depending on the characteristics of wet and dry spells and on the crop stage when a deficit occurs.

Therefore models that simulate the dynamic interactions between rainfall, the soil water balance and a crop's growth and development processes tend to provide more accurate estimates of yields than can be obtained from statistical relationships with seasonal average weather.

The accuracy-lead time tradeoff

Within a growing season, the accuracy of a crop production forecast will generally improve with decreasing lead-time. Consider a simple yield forecasting system that simulates crop growth with antecedent weather observations up to a given forecast date sometime within the season, then samples weather data from each available past year to simulate the remainder of growing season (Figure 5b). The resulting distribution, which approximates the climatic component of uncertainty, will necessarily narrow as the forecast date advances through the growing season (especially when the crop approaches growth stages that are critical for determining yields), and an increasing proportion of weather data is observed rather than sampled

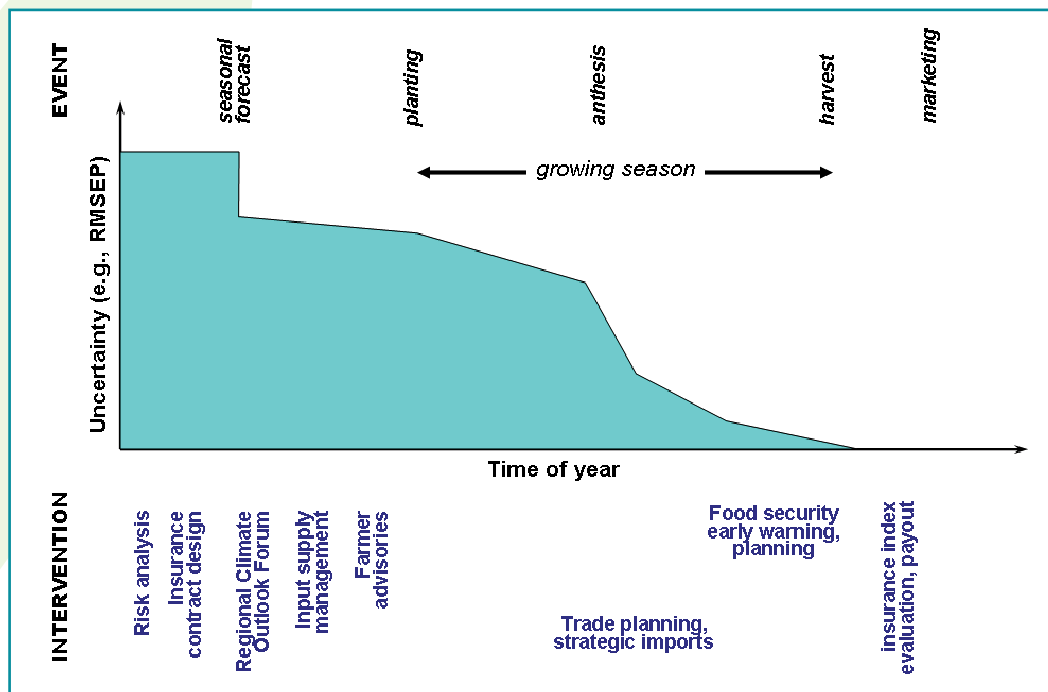


Figure 4. Timing of information needs for several risk management interventions, and accuracy-lead time tradeoff in a stylized crop forecasting system.

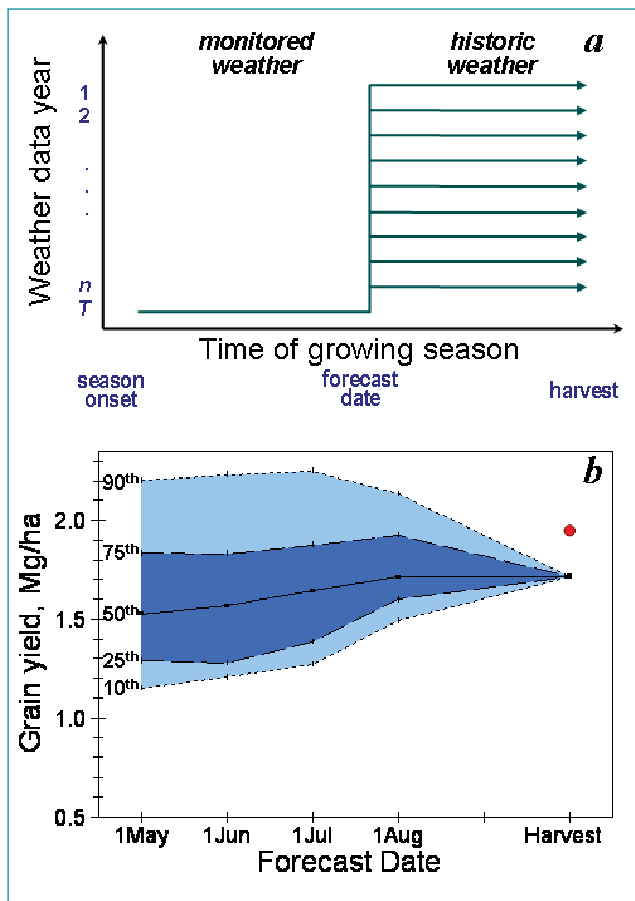


Figure 5. (a) Schematic of simulating with antecedent weather data in year T, and all other years of within-season weather data, to characterize the climatic component of uncertainty (after (Hansen et al., 2006)); and (b) resulting forecast distribution illustrated for 1989 climatology-based Queensland, Australia wheat forecast, showing forecast percentiles by forecast date, and observed yield (based on Hansen et al., 2004).

from the climatological distribution (Figure 5a). The uncertainties of crop yield forecasts made before sowing or early in the growing season can be very large.

In principle, the best outcomes should result when the degree of uncertainty of advance information is understood and factored into decisions. Presenting yield forecasts in probabilistic terms, updated continuously as the growing season unfolds, will allow decision makers to weigh the tradeoff between lead time and accuracy, assess when evidence of an impending threat is sufficiently certain to warrant action, and hopefully contribute toward more timely decisions based on more objective rules. This is most apparent in the case of management of food crises, where there is a clear tradeoff between timeliness and targeting, but is also relevant for management of trade and price

fluctuations, and for within-season farm decision-making. While farmers are locked into some decisions once the crop is planted, tactical decisions such as split fertilizer rates, and intensity of weeding and pest control can take advantage of the increasing accuracy as the season progresses.

Improving lead-time and accuracy

By reducing the range of variability of weather for the remainder of a growing season, the ability to predict rainfall at a seasonal lead-time raises the prospect of increasing accuracy (at a given lead-time) and lead-time (at a given accuracy) of crop production forecasts made within the growing season. This has been demonstrated, for example, for wheat in eastern Australia (Hansen et al., 2004) and sorghum in Burkina Faso (Mishra et al., 2008). Because the proportion of total uncertainty due to climate decreases through the growing season, the potential improvement in accuracy from incorporating seasonal forecasts is expected to be greatest early in the growing season (Hansen et al., 2006). For forecasts made before the start of the growing season and at a lead-time that allows farmers to adjust strategic decisions, there is suggestive evidence (Cane et al., 1994; Dilley, 1997; Hansen, 2005; Mishra et al., 2008; Rosenzweig, 1994) and at least one demonstration (Hansen et al., 2004) that crop yields may be more predictable than growing season rainfall. This is because initial soil moisture storage and early rainfall, prior to the forecast date, provide some information about final yield; and because most of the predictability of seasonal rainfall is due to predictability of frequency of rainfall events (Camberlin et al., 2009; Hansen and Indeje, 2004; Moron et al., 2006; Moron et al., 2007), which are associated with sequences of dry and wet spells and hence influence the soil water balance and crop response. Model-based crop forecasts can exploit this information, which is typically discarded when seasonal rainfall forecasts are presented.

Satellite remote sensing provides a complementary source of near real-time, spatially contiguous information about the state of the crop and soil. Data assimilation techniques can optimally integrate remote sensing information into agricultural systems models to improve accuracy, reducing the accumulation of errors associated with crop model structure, initial conditions and input data. Information about the state of the crop canopy from remote sensing can be used to update the state variables of a crop simulation model during the growing season, calibrate

model input parameters, or statistically correct final yield simulations (Dorigo et al., 2007; Moulin et al., 1998). There is also potential to assimilate remote sensing of soil surface moisture content, which is expected to improve with the planned launch of the Soil Moisture Active Passive (SMAP) satellite, into the soil water balance component of crop models (Das and Mohanty, 2006; Ines and Mohanty, 2009).

Dealing with data scarcity

Availability of quality, spatially contiguous data (e.g., meteorological, soil, crop distribution, production statistics) required to reliably estimate or predict crop response to climate is a challenge in much of SSA. Ongoing investment (AfricaSoils.net) is improving the coverage of reliable soil data. Needed dynamic data that comes with historic time series information (i.e., agricultural production, weather) are more challenging. Long-term records (required to downscale seasonal forecasts and to quantify accuracy and risk) of rainfall data at a sufficiently high spatial (required to locate areas at risk) and temporal resolution (required for realistic soil water balance and crop response to rainfall timing) are particularly important for model-based crop forecasting. Rain gauge coverage over most of Africa is seriously inadequate, and reporting rates have been declining (Washington, 2006). Data rescue is needed to digitize older paper archives, and in some cases, to locate records that may reside in former European colonial powers.

Satellite remote sensing provides a complementary source of rainfall estimates with complete spatial coverage. Merging station and satellite data on a daily time step has the potential to fill gaps in space and time. Current satellite-based rainfall data products are limited by their short duration, and often by coarse spatial and temporal resolution. METEOSAT geostationary satellite images extend back to 1978, with full spatial coverage of Africa at a frequency of at least two images per hour and a spatial resolution of roughly 3-6 km. Removing biases in satellite rainfall estimates requires local calibration, ideally using the full set of quality controlled stations that each country maintains rather than the small fraction that are publically available. With modest investment and cooperation of national meteorological services, it is feasible to process and merge older satellite images with all available observations to produce a ≥ 30 -year, roughly 10 km gridded, daily rainfall time series across SSA.

Expanding the role of value-added climate information

Improvements in climate information products, such as those discussed in the previous section, will not be sufficient to improve management of climate risk for smallholder agriculture or meet the needs of all agricultural stakeholders. A multi-stakeholder, cross-sectoral assessment of the use of climate information in Africa concluded that merely improving the supply in climate data or observing infrastructure would have little impact on development (IRI, 2006). It attributed the substantial gap in the provision and use of climate information to “market atrophy” associated with long-term interaction between ineffective demand by development stakeholders and inadequate supply of relevant climate information services. Several gaps need to be addressed in parallel to improved delivery of climate information, if value-added climate information is to contribute significantly to efforts by AGRA and others to improve the livelihoods of African farmers.

Climate data

In SSA, an average of one station per 26,000 km², or 1/8 the minimum recommended by the World Meteorological Organization (WMO), reports observations through the WMO (Washington, 2006). Observing infrastructure has deteriorated and reporting rates have declined over the past 2-3 decades. Substantial investment is needed to reverse these declines and enhance spatial coverage of observation infrastructure, and to rescue and digitize paper records. As discussed earlier, there is opportunity to supplement the sparse observation record with spatially contiguous, high-resolution satellite rainfall estimates. However, typical restrictive data policies prevent any investment in observing systems from translating into development impact. There is an urgent need for policy to treat climate data as a public good and a resource for development.

Climate information services

Structural reform policies in the 1990s encouraged national meteorological services (NMS) to raise revenues to supplement shrinking public funds. In many cases, the unfortunate impacts include: (i) treating data as a source of revenue rather than a public good, (ii) prioritizing commercial aviation over other sectors such as agriculture, and (iii) reducing the capacity of NMS to provide services to agriculture. Where this has happened, NMS need to be realigned, resourced and trained as providers of services for development and participants in the development process.

Mali's agro-meteorological information service is often cited as a model for SSA (Hellmuth et al., 2007). Information disseminated to the farming community includes 10-day agro-meteorological bulletins and short-range weather forecasts, but not seasonal forecasts. Multidisciplinary working groups helped bridge a divide between climate, agricultural, and emergency response communities that has frustrated efforts elsewhere in Africa. A set of participating farmers tests and refines services, disseminates information to the broader rural population, and evaluates impacts. On-farm evaluations showed substantial apparent yield and income benefits. Cooperating farmers test and refine services, disseminate information to the broader rural population, and evaluate impacts. On-farm evaluations suggest that the information service has improved farm management, fostered adoption of new technologies, and stimulated demand for additional information.

Delivery mechanisms

Because of their dispersion, poor state of rural communication infrastructure, and weakness of many national agricultural extension systems in SSA, effective and timely information delivery to smallholder farmers is a particular challenge. Pilot-scale research focused on agricultural applications of seasonal forecasts has explored several delivery mechanisms, and provides useful insights. Group interaction with a trained facilitator appears to be the most effective method for communicating climate information in a way that farmers can use. A workshop setting allows a facilitator to use a combination of visual and narrative methods to present local forecast and historic climate information, provide help with understanding probabilistic information, facilitate discussion about management responses, and provide feedback to improve climate information products and services (Hansen et al., 2007; Patt et al., 2005; Roncoli et al., 2009). Group interaction among farmers appears to contribute a great deal to understanding, and to willingness and ability to act on climate information (Marx et al., 2007; Roncoli et al., 2009). Where they are functional, climate information services should ideally be integrated as a routine part of agricultural extension services. Where agricultural extension services are not able to meet the demand, agribusiness and NGOs may have potential to serve as communication intermediaries, although experience with a parastatal cotton company in Burkina Faso suggests that there might be incentive to manipulate the delivery or interpretation of information to protect business interests (Ingram et al., 2002).

ICT-based communication (radio, cell phones, internet) offers potential to support timely delivery of climate information to rural communities at relatively low cost, but cannot replace the trust, visual communication of location-specific information, feedback and mutual learning that face-to-face interaction provides. In Africa, rural radio is probably the lowest cost vehicle for delivering climate information to rural communities at a large scale. Initiated in 1997 by the African Center for Meteorological Applications for Development (ACMAD), RANET (Radio and Internet for the Communication of Hydro-Meteorological and Climate Related Information) combines digital satellite technology, weather and climate information, low-cost community-owned radio stations, and wind-up radio receivers, to provide climate and other information to remote communities in several African countries (Boulaya et al., 2005). Facilitated radio listening groups, tested in Uganda, combine the benefits of media-based dissemination and facilitated group interaction (Orlove and Roncoli, 2006; Phillips and Orlove, 2004). The proliferation of mobile phone technology in rural SSA can potentially be exploited, particularly for information that is required frequently and with short lead-time. In India, the M.S. Swaminathan Research Foundation and others promote "Village Knowledge Centers" as a means to provide information to rural communities and to empower the women who are trained to operate them. It is an attractive model for delivering relevant and timely climate information to agricultural stakeholders (Raj, 2005), but the poor state of Internet connectivity will limit its application in SSA in the near term.

Early response mechanisms

The availability of early warning information is a necessary but not sufficient condition for effective response to an emerging food crisis. If food crisis management is to protect long-term livelihood potential, the availability of early warning information must be coupled with investment in well-targeted early response capacity. A number of sophisticated early warning systems have been developed independently of the political response process. In other cases, the decision process is poorly defined, subjective, and prone to political pressure. In the best cases, existing institutional procedures that require a high degree of certainty before taking action contribute to delays in responding to emerging food crises (Broad and Agrawala, 2000; Haile, 2005), and need to be adjusted to accommodate anticipated improvements in early warning information. Long-lead, climate-informed, probabilistic early warning of food

production shortfalls should be coupled with quantitative, spatial indicators of vulnerability, and with parametric response trigger mechanisms (Byerlee et al., 2006), particularly given the combination of new opportunity and increased complexity that explicitly probabilistic, long-lead information introduces. International organizations such as the UN World Food Programme increasingly recognize the need for a more proactive approach to food crisis prevention and early response. For crises that require international assistance, financing – often delayed either by the appeal process of host governments or by donors that wait for impacts to reach the media before they act – is a bottleneck that needs urgent attention (Haile, 2005). Response to localized climate shocks may be strengthened through community level early response mechanisms such as disaster management committees, assuming that effective information delivery mechanisms can also be put in place (as discussed above).

Coordination

Each of the opportunities to manage climate risk discussed in earlier in this paper depends on effective collaboration among stakeholders at several levels. Different interventions are needed in climatically favorable and climatically adverse years. The ability to anticipate climate conditions near the start of the growing season seems to offer some prospect for reducing resource competition and exploiting potential synergies between short-term food crisis management, and intensified production needed for long-term development (Barrett and Carter, 2001). Coordination among farmer demand for production inputs, the input supply chain, and credit supply would improve the prospect for taking advantage of favorable climatic conditions. Poor coordination between government and small-scale private sector traders can undermine efforts to manage trade to control price volatility (Jayne et al., 2006). Coordination among insurers, rural banks, input suppliers, and marketing through a farmer association seemed to be a factor in the apparent success of the Malawi groundnut insurance pilot project (Hellmuth et al., 2009; Hess and Syroka, 2005) discussed earlier. Given ideological differences between communities, economic interests of the substantial relief industry built around food crisis response, and the historic separation of humanitarian relief, agricultural development and meteorological institutions within national governments and even the UN, developing effective coordination among the relevant stakeholders may prove to be among the

most difficult challenges to managing risk for the benefit of smallholder agriculture in SSA.

Conclusions

Climate-related risk is one of several obstacles to improving livelihoods and making markets work for smallholder farmers in Sub-Saharan Africa. The ex-post and ex-ante impacts of covariant climate shocks such as drought overwhelm traditional rural risk management strategies, and are appropriate targets for development investment. Weather index insurance addresses some of the challenges that have made insurance infeasible for smallholder farmers in rainfed environments. Yet insurance is not a panacea, but a complement to a range of other relevant risk management interventions. A more holistic approach to reducing the negative impacts of climate risk also includes adaptive management at the farm and input supply chain levels, food crisis management (a form of insurance), and the use of trade and perhaps storage to manage price volatility. These interventions have not been fully exploited, in part because of gaps in existing climate information products and services. Typically, either (i) development applications that deal with climate risk are constrained to make do with whatever information is readily available, leading to ineffective demand, or (ii) information needs are addressed on an ad-hoc basis for each application or stakeholder, often at a pilot scale, and often just for the duration of a funded project. There is considerable overlap in the type of information required by the various risk management interventions that we discussed. Information-related constraints to several interventions could be alleviated by investing in a common climate-informed crop monitoring and forecasting platform. We discuss several technically feasible opportunities to add value to raw climate information.

Institutional and policy constraints related to climate data, information services, communication, response capacity and coordination must also be addressed if climate information is to serve the needs of farmers and market stakeholders in SSA. While these do not seem to be intractable, they are likely to be more challenging than the technical issues related to climate information. Given the pervasive influence that climate risk has on farmer livelihoods and market participation, they may be worthwhile targets for investment and advocacy.

References

- Abdulai, A., C.B. Barrett and J. Hoddinott. 2005. "Does food aid really have disincentive effects? New evidence from sub-Saharan Africa." *World Development* 33: 1689-1704.
- Abdulai, A., C.B. Barrett and P. Hazell. 2004. "Food aid for market development in Sub-Saharan Africa." DSGD Discussion Paper No. 5. International Food Policy Research Institute. Washington, DC.
- Alderman, H., J. Hoddinott and W. Kinsey. 2006. "Long term consequences of early childhood malnutrition." *Oxford Economic Papers* 58: 450-474.
- Anderson, W.K. 1984. "Plant populations for triticale in a Mediterranean environment." *Field Crops Research* 8: 281-295.
- Archer, E.R.M. 2003. "Identifying underserved end-user groups in the provision of climate information." *Bulletin of the American Meteorological Society* 84: 1525-1532.
- Arndt, C. and M. Bacou. 2000. "Economy wide effects of climate variability and prediction in Mozambique." *American Journal of Agricultural Economics* 82: 750-754.
- Arndt, C., M. Bacou, and A. Cruz. 2003. "Climate forecasts in Mozambique: an economic perspective." In: *Coping with Climate Variability: The Use of Seasonal Climate Forecasts in Southern Africa*. K. O'Brien and C. Vogel (eds.). pp. 129-152. Ashgate Publishing, Abingdon, UK.
- Arndt, C., M. Bacou, and A. Cruz. 2003. "Climate forecasts in Mozambique: an economic perspective." In: *Coping with Climate Variability: The Use of Seasonal Climate Forecasts in Southern Africa*. K. O'Brien and C. Vogel (eds.). pp. 129-152. Ashgate Publishing, Abingdon, UK.
- Barrett, C.B., C.M. Moser, O.V. McHugh and J. Barison. 2004. "Better Technology, Better Plots or Better Farmers? Identifying Changes In Productivity And Risk Among Malagasy Rice Farmers." *American Journal of Agricultural Economics* 86: 869-888.
- Barrett, C.B. 2002. "Food Security and Food Assistance Programs." In: *Handbook of Agricultural Economics*. B. L. Gardner and G. C. Rausser (eds.). Elsevier Science, Amsterdam.
- Barrett, C.B. 2005. "Rural poverty dynamics: development policy implications." *Agricultural Economics* 32: 45-60.
- Barrett, C.B. 2007. "Smallholder Market Participation: Concepts and Evidence from Eastern and Southern Africa." *FAO workshop on Staple Food Trade and Market Policy Options for Promoting Development in Eastern and Southern Africa*, Rome, 1-2 March 2007.
- Barrett, C.B., and B.M. Swallow. 2006. "Fractal poverty traps." *World Development* 34: 1-15.
- Barrett, C.B. and M.R. Carter. 2001. "Can't get ahead for falling behind: development policy, poverty, and relief traps." *Choices*. Winter, 2001-2002: 35-38.
- Barrett, C.B., B.J. Barnett, M.R. Carter, S. Chantarat, J.W. Hansen, A.G. Mude, D.E. Osgood, J.R. Skees, C.G. Turvey and M.N. Ward. 2007. "Poverty Traps and Climate Risk: Limitations and Opportunities of Index-Based Risk Financing." IRI Tech. Rep. No. 07-03. International Research Institute for Climate and Society, Palisades, New York, USA.
- Besley, T. 1995. "Property Rights and Investment Incentives: Theory and Evidence from Ghana." *Journal of Political Economy* 103: 903-937.
- Binswanger, H. and D.A. Sillers. 1983. "Technological priorities for farming in Sub-Saharan Africa." *World Bank Research Observer* 3: 81-98.
- Boulahya, M., M. Stewart-Cerda, M. Pratt and K. Sponberg. 2005. "Climate, communications, and innovative technologies: Potential impacts and sustainability of new radio and Internet linkages in rural African communities." *Climatic Change* 70: 299-310.
- Broad, K. and S. Agrawala. 2000. "The Ethiopia food crisis – uses and limits of climate forecasts." *Science* 289: 1693-1694.
- Brown, C., R. Meeks and K. Hunu. 2008. "Climate change and economic growth in Sub-Saharan Africa: An assessment of climate risk." *Africa Economic Research Consortium Senior Symposium 10*, Addis Ababa, 7-9 April 2008.
- Byerlee, D., T.S. Jayne and R.J. Myers. 2006. "Managing food price risks and instability in a liberalizing market environment: Overview and policy options." *Food Policy* 31: 275-287.
- Camberlin, P., V. Moron, R. Okoola, N. Philippon and W. Gitau. 2009. "Components of rainy seasons' variability in Equatorial East Africa: Onset, cessation, rainfall frequency and intensity." *Theoretical and Applied Climatology* DOI 10.1007/s00704-009-0113-1.
- Cane, M.A., G. Eshel and R.W. Buckland. 1994. "Forecasting Zimbabwean maize yield using eastern equatorial Pacific sea surface temperature." *Nature* 16: 3059-3071.
- Carriquiry, M. and D. Osgood. 2008. "Index Insurance, Production Practices, and Probabilistic Climate Forecasts."
- Carter, M.R. and C.B. Barrett. 2006. "The economics of poverty traps and persistent poverty: An asset-based approach." *Journal of Development Studies* 42: 178-199.
- Carter, M.R., P.D. Little, T. Mogues and W. Negatu. 2007. "Poverty traps and natural disasters in Ethiopia and Honduras." *World Development* 35: 835-856.
- Cash, D.W., J.C. Borck and A. Patt, G. 2006. "Countering the loading dock approach to linking science and decision making: Comparative analysis of El Niño/Southern Oscillation (ENSO) forecasting systems." *Science, Technology & Human Values* 31: 465-494.
- Chen, C-C., B.A. McCarl, and C-C. Chang. 2008. "Strong El Niño–Southern Oscillation events and the economics of the international rice market." *Climate Research* 36: 113-122.

- Christianson, C.B. and P.L.G. Vlek. 1991. "Alleviating soil fertility constraints to food production in West Africa: Efficiency of nitrogen fertilizers applied to food crops." *Fertilizer Research* 29: 21-33.
- Das, N.N. and B.P. Mohanty. 2006. "Root zone soil moisture assessment using remote sensing and vadose zone modeling." *Vadose Zone Journal* 5: 296-307.
- Dercon, S. 1996. "Risk, crop choice, and savings: Evidence from Tanzania." *Economic Development and Cultural Change* 44: 485-513.
- Dercon, S. 2004. "Growth and shocks: Evidence from rural Ethiopia." *Journal of Development Economics* 74: 309-329.
- Dercon, S. and J. Hoddinott. 2005. "Health, Shocks and Poverty Persistence." In: *Insurance Against Poverty*. S. Dercon (ed.). Oxford University Press, Oxford, UK.
- Dercon, S. and L. Christiaensen. 2007. "Consumption risk, technology adoption and poverty traps: Evidence from Ethiopia." *World Bank Policy Research Working Paper* 4257. The World Bank. Washington, DC.
- Dilley, M. 1997. "Climatic factors affecting annual maize yields in the valley of Oaxaca, Mexico." *International Journal of Climatology* 17: 1549-1557.
- Dorigo, W.A., R. Zurita-Milla, A.J.W. d. Wit, J. Brazile, R. Singh and M.E. Schaeppman. 2007. "A review on reflective remote sensing and data assimilation techniques for enhanced agro-ecosystem modeling." *International Journal of Applied Earth Observation and Geoinformation* 9: 165-193.
- Easterly, W. 2001. "The Elusive Quest for Growth." MIT Press, Cambridge, Mass, USA.
- Elbers, C., J.W. Gunning and B. Kinsey. 2007. "Growth and risk: Methodology and micro evidence." *World Bank Economic Review* 21: 1-20.
- Fafchamps, M. 1992. "Cash crop production, food price volatility and rural market integration in the third world." *American Journal of Agricultural Economics* 74: 90-99.
- Fafchamps, M. 2003. "Rural Poverty, Risk and Development." Edward Elgar Publishing, Glos, UK.
- Gaiha, R. and G. Thapa. 2006. "Natural Disasters, Vulnerability and Mortalities – A Cross-Country Analysis." International Fund for Agricultural Development, Rome.
- Gine, X. and D. Yang. 2007. "Insurance, Credit, and Technology Adoption: Field Experimental Evidence from Malawi." The World Bank. Washington, DC.
- Glantz, M.H. (ed.). 2001. "Once Burned, Twice Shy? Lessons Learned from the 1997/98 El Niño." United Nations University Press, Tokyo.
- Gong, X., A. Barnston and M. Ward. 2003. "The effect of spatial aggregation on the skill of seasonal precipitation forecasts." *Journal of Climate* 16: 3059-3071.
- Haile, M. 2005. "Weather patterns, food security and humanitarian responses in Sub-Saharan Africa." *Philosophical Transactions of the Royal Society B: Biological Sciences* 360: 2169-2182.
- Hallstrom, D.G. 2004. "Inter-annual climate variation, climate prediction, and agricultural trade: The costs of surprise versus variability." *Review of International Economics* 12: 441-455.
- Hansen, J.W. 2002. "Realizing the potential benefits of climate prediction to agriculture: Issues, approaches, challenges." *Agricultural Systems* 74: 309-330.
- Hansen, J.W. 2005. "Integrating seasonal climate prediction and agricultural models for insights into agricultural practice." *Philosophical Transactions of the Royal Society B: Biological Sciences* 360: 2037-2047.
- Hansen, J.W., A. Challinor, A.V.M. Ines, T. Wheeler and V. Moron. 2006. "Translating climate forecasts into agricultural terms: Advances and challenges." *Climate Research* 33: 27-41.
- Hansen, J.W., A. Mishra, K.P.C. Rao, M. Indeje and R.K. Ngugi. 2009. "Potential value of GCM-based seasonal rainfall forecasts for maize management in semi-arid Kenya." *Agricultural Systems* 101: 80-90.
- Hansen, J.W., A. Potgieter and M. Tippett. 2004. "Using a general circulation model to forecast regional wheat yields in Northeast Australia." *Agricultural and Forest Meteorology* 127: 77-92.
- Hansen, J.W. and M. Indeje. 2004. "Linking dynamic seasonal climate forecasts with crop simulation for maize yield prediction in semi-arid Kenya." *Agricultural and Forest Meteorology* 125: 143-157.
- Hansen, J.W., W. Baethgen, D. Osgood, P. Ceccato and R.K. Ngugi. 2007. "Innovations in climate risk management: Protecting and building rural livelihoods in a variable and changing climate." *Journal of Semi-Arid Tropical Agricultural Research* 4 (1). (published online at <http://www.icrisat.org/Journal/specialproject.htm>)
- Hellmuth, M.E., A. Moorhead, M.C. Thomson and J. Williams (eds.). 2007. "Climate Risk Management in Africa: Learning from Practice." International Research Institute for Climate and Society, Columbia University, New York.
- Hellmuth, M.E., D.E. Osgood, U. Hess, A. Moorhead and H. Bhojwani (eds.). 2009. "Index Insurance and Climate Risk: Prospects for Development and Disaster Management." *Climate and Society* No. 2. International Research Institute for Climate and Society, Palisades, New York, USA.
- Hess, U. and J. Syroka. 2005. "Weather-based Insurance in Southern Africa: The Case of Malawi." *Agriculture and Rural Development Discussion Paper* 13. The World Bank, Washington, DC.
- Hoddinott, J. 2006. "Shocks and their consequences across and within households in rural Zimbabwe." *Journal of Development Studies* 42: 301-321.
- Hoddinott, J. 2008. "Social safety nets and productivity enhancing investments in agriculture. Convergence between social services provision (SSP) and productivity enhancing investments in development strategies: How to maximize the impact of public expenditure on agricultural growth and poverty reduction." Pietermaritzburg, South Africa, 29-31 January 2008.

- Huda, A.K.S., R. Selvaraju, T.N. Balasubramanian, V. Geethalakshmi, D.A. George and J.F. Clewett. 2004. "Experiences of using seasonal climate information with farmers in Tamil Nadu, India." In: *Using Seasonal Climate Forecasting in Agriculture: a Participatory Decision-making Approach*. A.K.S. Huda and R.G. Packham (eds.). Australian Centre for International Agricultural Research, Canberra.
- Ines, A.V.M. and B.P. Mohanty. 2009. "Near-surface soil moisture assimilation for quantifying effective soil hydraulic properties using genetic algorithm. 2. Using air-borne remote sensing during SGP97 and SMEX02." *Water Resources Research* 45: W01408.
- Ingram, K.T., M.C. Roncoli and P.H. Kirshen. 2002. "Opportunities and constraints for farmers of west Africa to use seasonal precipitation forecasts with Burkina Faso as a case study." *Agricultural Systems* 74: 331-349.
- IRI. 2006. "A Gap Analysis for the Implementation of the Global Climate Observing System Programme in Africa." International Research Institute for Climate and Society, Palisades, New York.
- Jayne, T.S., B. Zulu and J.J. Nijhoff. 2006. "Stabilizing food markets in eastern and southern Africa." *Food Policy* 31: 328-341.
- Jones, J.W., J.W. Hansen, F.S. Royce and C.D. Messina. 2000. "Potential benefits of climate forecasting to agriculture." *Agriculture, Ecosystems and Environment* 82: 169-184.
- Kebede, Y. 1992. "Risk behavior and new agricultural technologies: The case of producers in the central highlands of Ethiopia." *Quarterly Journal of International Agriculture* 31: 269-284.
- Kelly, V., A.A. Adesina and A. Gordon. 2003. "Expanding access to agricultural inputs in Africa: A review of recent market development experience." *Food Policy* 28: 379-404.
- Luo, H., J.R. Skees and M.A. Marchant. 1994. "Weather Information and the Potential for Inter-temporal Adverse Selection in Crop Insurance." *Review of Agricultural Economics* 16: 441-451.
- Malusalila, P.M. 2000. "Experiences of an agricultural input supplier." In: *Proceedings of the International Forum on Climate Prediction, Agriculture and Development*. pp. 82-86. International Research Institute for Climate and Society, Palisades, New York.
- Marra, M., D.J. Pannell and A.A. Ghadim. 2003. "The economics of risk, uncertainty and learning in the adoption of new agricultural technologies: Where are we on the learning curve?" *Agricultural Systems* 75: 215-234.
- Marx, S.M., E.U. Weber, B.S. Orlove, A. Leiserowitz, D.H. Krantz, C. Roncoli and J. Phillips. 2007. "Communication and mental processes: Experiential and analytic processing of uncertain climate information." *Global Environmental Change* 17: 47-58.
- McCarthy, N. 2003. "Demand for Rainfall-Index Based Insurance: A Case Study from Morocco." EPTD Discussion Paper 106. International Food Policy Research Institute, Washington, DC.
- McPeak, J.G. and C.B. Barrett. 2001. "Differential risk exposure and stochastic poverty traps among East African pastoralists." *American Journal of Agricultural Economics* 83: 674-679.
- Meinke, H., R. Nelson, P. Kokic, R. Stone, R. Selvaraju and W. Baethgen. 2006. "Actionable climate knowledge: From analysis to synthesis." *Climate Research* 33: 101-110.
- Miranda, M.J. and J.W. Glauber. 1997. "Systemic risk, reinsurance, and the failure of crop insurance markets." *American Journal of Agricultural Economics* 79: 206-215.
- Mishra, A., J.W. Hansen, M. Dingkuhn, C. Baron, S.B. Traoré, O. Ndiaye and M.N. Ward. 2008. "Sorghum yield prediction from seasonal rainfall forecasts in Burkina Faso." *Agric. For. Meteorol.* 148: 1798-1814.
- Morduch, J. 1990. "Risk, Production and Savings: Theory and Evidence from Indian Households." Harvard Univ., Dept. of Economics, Cambridge, Mass.
- Moron, V., A.W. Robertson and M.N. Ward. 2006. "Seasonal predictability and spatial coherence of rainfall characteristics in the tropical setting of Senegal." *Monthly Weather Review* 134: 3248-3262.
- Moron, V., A.W. Robertson and M.N. Ward. 2007. "Spatial coherence of tropical rainfall at regional scale." *Journal of Climate* 20: 5244-5263.
- Morris, M., V.A. Kelly, R. Kopicki and D. Byerlee. 2007. "Fertilizer Use in African Agriculture: Lessons Learned and Good Practice Guidelines." The World Bank, Washington, DC.
- Moulin, S., A. Bondeau and R. Deleâ Colle. 1998. "Combining agricultural crop models and satellite observations: From field to regional scales." *Int. J. Remote Sensing* 19: 1021-1036.
- Mude, A. 2011. "Index Based Livestock Insurance for Northern Kenya's Arid and Semi-Arid Lands: The Marsabit Pilot." Towards Priority Actions for Market Development for African Farmers, Nairobi, Kenya (this volume).
- Myers, R.J.K. and M.A. Foale. 1981. "Row spacing and population density in grain sorghum – a simple analysis." *Field Crops Research* 4: 147-154.
- NEPAD. 2002. "Comprehensive Africa Agriculture Development Programme." New Partnership for Africa's Development (NEPAD), Johannesburg.
- Ngugi, R.K. 2002. "Climate Forecast Information: The Status, Needs and Expectations among Smallholder Agro-pastoralists in Machakos District, Kenya." IRI Tech. Rep. No. 02-04. International Research Institute for Climate and Society, Palisades, New York, USA.
- O'Brien, K., L. Sygna, L.O. Næss, R. Kingamlono and B. Hochobeb. 2000. "Is Information Enough?" User Responses to Seasonal Climate Forecasts in Southern Africa Center for International Climate and Environmental Research, Oslo.
- Orlove, B.S. and C. Roncoli. 2006. "Integration of Climate Information from Multiple Sources through Group Discussion in Ugandan Farm Communities." Center for Research on Environmental Decisions, Columbia University, New York.

- Osgood, D., M. McLaurin, M. Carriquiry, A. Mishra, F. Fiondella, J. Hansen, N. Peterson and N. Ward. 2007. "Designing Weather Insurance Contracts for Farmers in Malawi, Tanzania, and Kenya." Final Report to the Commodity Risk Management Group, ARD, World Bank 07-02. International Research Institute for Climate and Society, New York.
- Osgood, D.E., P. Suarez, J.W. Hansen, M. Carriquiry and A. Mishra. 2008. "Integrating Seasonal Forecasts and Insurance for Adaptation among Subsistence Farmers: The Case of Malawi." World Bank Policy Research Working Paper No. 4651, World Bank, Washington, DC. (available online at: <http://go.worldbank.org/N06IVKVTM0>).
- Pala, M., A. Matar and A. Mazid. 1996. "Assessment of the effects of environmental factors on the response of wheat to fertilizer in on-farm trials in Northern Syria." *Experimental Agriculture* 32: 339-349.
- Patt, A., P. Suarez and C. Gwata. 2005. "Effects of seasonal climate forecasts and participatory workshops among subsistence farmers in Zimbabwe." *Proceedings of the National Academy of Sciences* 102: 12623-12628.
- Patt, A.G., L.J. Ogallo and M. Hellmuth. 2007. "Learning from 10 years of climate outlook forums in Africa." *Science* 318: 49-50.
- Paxon, C. 1992. "Using weather variability to estimate the response of savings to transitory income in Thailand." *American Economic Review* 82: 15-33.
- Phillips, J. 2003. "Determinants of forecast use among communal farmers in Zimbabwe. In: *Coping with Climate Variability: The Use of Seasonal Climate Forecasts in Southern Africa*. K. O'Brien and C. Vogel (eds.). pp. 110-126. Ashgate Publishing, Abingdon, UK.
- Phillips, J.G. and B.S. Orlove. 2004. "Improving climate forecast communications for farm management in Uganda." Final Report to NOAA Office of Global Programs.
- Phillips, J.G., D. Deane, L. Uganai and A. Chimeli. 2002. "Implications of farm-level response to seasonal climate forecasts for aggregate grain production in Zimbabwe." *Agricultural Systems* 74: 351-369.
- Phillips, J.G., L. Uganai and E. Makaudze. 2001. "Current and potential use of seasonal climate forecasts for resource-poor farmers in Zimbabwe. In: *Impacts of El Niño and Climate Variability on Agriculture*. ASA Special Publication No. 63. C. Rosenzweig, et al. (eds.). pp. 87-100. American Society of Agronomy, Madison, Wisconsin.
- Piha, M. 1993. "Optimising fertiliser use and practical rainfall capture in a semi-arid environment with variable rainfall." *Experimental Agriculture* 29: 405-415.
- Pope, R. and R.E. Just. 1991. "On testing the structure of risk preferences in agricultural supply analysis." *American Journal of Agricultural Economics* 73: 743-748.
- Poulton, C., J. Kydd and A. Dorward. 2006a. "Overcoming market constraints on pro-poor agricultural growth in sub-Saharan Africa." *Development Policy Review* 24: 243-277.
- Poulton, P.L., J. Kydd, S. Wiggins and A. Dorward. 2006b. "State intervention for food price stabilisation in Africa: Can it work?" *Food Policy* 31: 342-356.
- Raj, R. 2005. "Localized Climate Forecasting System: Seasonal Climate and Weather Prediction for Farm Level Decision-making." Final project report. M.S. Swaminathan Research Foundation, Chennai, India.
- Roncoli, C., C. Jost, P. Kirshen, M. Sanon, K.T. Ingram, M. Woodin, L. Somé, F. Ouattara, B.J. Sanfo, C. Sia, P. Yaka and G. Hoogenboom. 2009. "From accessing to assessing forecasts: An end-to-end study of participatory climate forecast dissemination in Burkina Faso (West Africa)." *Climatic Change* 92: 433-460.
- Rose, E. 2001. "Ex-ante and ex-post labor supply response to risk in a low-income area." *Journal of Development Economics* 64: 371-388.
- Rosenzweig, C. 1994. "Maize suffers a sea-change." *Nature* 370: 175-176.
- Rosenzweig, M.R. and H. Binswanger. 1993. "Wealth, Weather Risk and the Composition and Profitability of Agricultural Investments." *The Economic Journal* 103: 56-78.
- Rosenzweig, M.R. and O. Stark. 1989. "Consumption smoothing, migration and marriage." *Journal of Political Economy* 97: 905-926.
- Royce, F.S., J.W. Jones and J.W. Hansen. 2001. "Model-based optimization of crop management for climate forecast applications." *Transactions of the American Society of Agricultural Engineers* 44: 1319-1327.
- Simtowe, F.P. 2006. "Can risk-aversion towards fertilizer explain part of the non-adoption puzzle for hybrid maize? Empirical evidence from Malawi." *Journal of Applied Sciences* 6: 1490-1498.
- Skees, J.R. and A. Enkh-Amgalan. 2002. "Examining the Feasibility of Livestock Insurance in Mongolia." World Bank Policy Research Working Paper Series: 2886. The World Bank, Washington, DC.
- Stayton, M. and U. Hess. 2006. "Ethiopia Drought Insurance Update and 2007 Weather Risk Management Workplan." World Food Programme, United Nations, Rome.
- Tarhule, A. and P.J. Lamb. 2003. "Climate Research and Seasonal Forecasting for West Africans." *Bulletin of the American Meteorological Society* 84: 1741-1759.
- Vogel, C. 2000. "Useable science: An assessment of long-term seasonal forecasts amongst farmers in rural areas of South Africa." *South African Geographical Journal* 82: 107-116.
- Washington, R., Harrison, M., Conway, D., Black, E., Challinor, A., Grimes, D., Jones, R., Morse, A., Kay, G. and Todd, M. 2006. "African climate change: taking the shorter route." *Bull. Amer. Meteor. Soc.* 87: 1355-1366.
- Wik, M. and S. Holden. 1998. "Experimental studies of peasant's attitudes toward risk in northern Zambia." Agricultural University of Norway – Department of Economics and Social Sciences.

Wiseman, W., and U. Hess. Submitted. "Reforming humanitarian finance in Ethiopia: A model for integrated risk financing." Food Policy.

World Bank. 2006. "Ethiopia: Managing water resources to maximize suitable growth." The World Bank. Washington, DC

Yesuf, M. and R. Bluffstone. 2007. "Risk Aversion in Low Income Countries: Experimental Evidence from Ethiopia." IFPRI Discussion Paper 00715. International Food Policy Research Institute. Washington, DC.

Ziervogel, G. 2004. "Targeting seasonal climate forecasts for integration into household level decisions: The case of small farmers in Lesotho." The Geographical Journal 170: 6-21.

Zimmerman, F.J. and M.R. Carter. 2003. "Asset smoothing, consumption smoothing and the reproduction of inequality under risk and subsistence constraints." Journal of Development Economics 71: 233-260.



Insuring against drought-related livestock mortality: Piloting index-based livestock insurance in northern Kenya

Andrew Mude¹, Sommarat Chantarat², Christopher B. Barrett³, Michael Carter⁴, Munenobu Ikegami⁵ and John McPeak^{6,7}

Abstract

Climate related shocks are among the leading cause of production and efficiency losses in smallholder crop and livestock production in rural Africa. Consequently, the identification of tools to help manage the risks associated with climatic extremities is increasingly considered to be among the key pillars of any agenda to enhance agricultural growth and welfare in rural Africa. This paper describes the application of a promising innovation in insurance design – index-based insurance – that seeks to bring the benefits of formal insurance to help manage the weather-related risks faced by rural crop and livestock producers in low-income countries. In particular, we highlight the research and development agenda of a comprehensive effort to design commercially viable index based livestock insurance aimed at protecting the pastoral populations of northern Kenya from the considerable drought-related livestock mortality risk that they face. Detailing the conditions that make the pastoral economy in northern Kenya an ideal candidate for the provision of index-based insurance products, the paper describes the contract design, defines its structure, offers analysis that indicates a high likelihood of commercial sustainability among the target market and describes the process of implementation leading up to the launch of a pilot in Marsabit District of northern Kenya in early 2010.

Introduction

Downside-production risk is a considerable constraint to agricultural production and development whose impact is particularly felt by smallholder farmers and livestock keepers whose meager resource base offers them few effective options to manage this risk. As is true in most of rural Africa, thin

markets, poor physical and institutional infrastructure and weak access to credit and savings markets compound the problem of production risk that poor farmers and livestock keepers face.

Climate extremities are the greatest source of agricultural production risk with droughts and floods resulting in total or partial crop failures as well as forage and water scarcity that reduce livestock productivity and, in severe cases, lead to widespread livestock losses (Thornton et al. 2008; Hellmuth et al. 2007; IPCC 2007). Over the past decade or so, natural disasters, particularly droughts and floods, have risen sharply worldwide with the biggest increase in low-income countries whose disaster incidence rose at twice the global rate (Tebaldi et al. 2006; IFCRSC 2004). In much of rural Africa, where water harvesting, irrigation and other similar water management methods are under developed and the impacts of climate change are expected to be especially pernicious, managing agricultural production risk becomes increasingly important (Thornton et al. 2008; Hellmuth et al. 2007).

The increasing recognition of the considerable risks faced by the smallholder agricultural sector and the non-trivial impact of these risks on agricultural growth and rural welfare have placed a spotlight on risk and lifted the management of risk to a place of priority with regards to interventions to catalyze agriculture in rural Africa (World Bank 2005; Barrett et al. 2007a). Consequently, the past several years have seen the development of innovative interventions for managing weather-related agricultural risk. Of these, index-based insurance products represent a promising and exciting market-based option for managing climate related risks that vulnerable households are exposed to.

The creation of insurance markets for events whose likelihood of occurrence can be precisely calculated and associated to a well defined index is increasingly being championed as a way by which the benefits of insurance can be offered to relatively poor and remote populations (World Bank 2005; Barrett et al.

¹ Economist, International Livestock Research Institute, Nairobi, Kenya. Corresponding author (a.mude@cgiar.org)

² Assistant Professor, Crawford School of Economics and Government, The Australian National University

³ Stephen B. and Janice G. Ashley Professor of Applied Economics and Management, Charles H. Dyson School of Applied Economics and Management, Cornell University

⁴ Professor and Director of BASIS Program, Agricultural and Resource Economics, University of California, Davis

⁵ Post-Doctoral Scientist, International Livestock Research Institute, Nairobi, Kenya

⁶ Associate Professor, Department of Public Administration, Syracuse University

⁷ **Author's Acknowledgements:** We thank ILRI-IBLI team members Oscar Naibei, Robert Ouma, Hellen Rugoiyo, Mohamed Shibia and Brenda Wandera whose efforts have been central to the success of the development and implementation of IBLI in Marsabit. We are grateful to our commercial and development partners at Equity Insurance Agency, UAP Insurance Co. Ltd., the Financial Sector Deepening Trust Kenya, Food for the Hungry Kenya, CARE, and KARI and others who were instrumental in both the research project and the pilot launch. We are thankful for the support of the Ministry for the Development of Northern Kenya and Other Arid Lands as well as the Arid Lands Resource Management Program. Ade Freeman, Nancy Johnson, John McDermott and Carlos Seré are gratefully acknowledged for their input and support. Throughout the research and development process numerous stakeholders, facilitators and enumerators and community members were engaged to help solicit information and exchange ideas about the IBLI process and product; too many to name individually, we are indebted to all for their time, enthusiasm and valuable information. Finally, we thank UK's Department for International Development (DFID), ILO's Microinsurance Facility, USAID's BASIS CRSP and the World Bank's Trust Fund for Socially Sustainable Development for funding and collaborate support. The views expressed are solely the authors' and do not represent any official agency. Any remaining errors are ours alone.

2007b; Skees and Collier 2008; Skees et al. 2006; Hellmuth et al. 2009). Index-based insurance holds considerable appeal for both commercial and development purposes because it allows for management of covariate risk – particularly those related with weather fluctuations – and avoids the serious adverse selection and moral hazard problems that have long plagued conventional crop and livestock insurance programs throughout the world.

This paper underscores the potential of index-based insurance to manage weather related risk faced by rural farmers and livestock keepers by highlighting a comprehensive effort to catalyze a commercial market for index-based livestock insurance (IBLI) in Marsabit District of northern Kenya. This IBLI product has many innovative features. It appears to be the first to develop the index insurance product from longitudinal household data so as to minimize basis risk in product design. It is one of the first developed to protect the productive asset holdings of the poor and vulnerable rather than just their income streams. It is one of the first to be based on more spatially distributed remotely-sensed vegetation data, rather than rainfall series from a sparse set of fixed point meteorological stations, as the IBLI index is derived from satellite-based normalized difference vegetation index (NDVI) series that summarize the state of rangeland forage availability at high spatiotemporal resolution. Finally, IBLI Marsabit was designed to complement a new (unconditional) cash transfer program (the Hunger Safety Nets Program, HSNP) the government launched in the area and the IBLI impact evaluation design explicitly enables identification of the independent and synergistic effects of HSNP and IBLI as alternative means of addressing the risk and financial constraints faced by the poor.

In the next section we summarize the main principles of index-based insurance contracts. In Section three, we start by highlighting some of the key characteristics of northern Kenya and its economy that make it particularly suitable for risk-management via index-based insurance contracts, then describe the various elements of the IBLI research and development agenda. Section four profiles the key processes involved in the implementation and sale of IBLI and finally, Section five concludes.

Index-based insurance

Like any insurance product, index-based insurance aims to compensate clients in the event of a loss. Unlike traditional insurance, which makes payouts based on case-by-case assessments of individual clients' loss realizations, index-based insurance pays policyholders based on an external indicator that triggers payment to all insured clients within a geographically defined space. For index insurance to work, there must be a suitable indicator variable (the index) that is highly correlated with the insured event. Using a data source that is promptly, reliably, and inexpensively available (and that cannot be manipulated by either the insurer or the insured), an index insurance contract makes the agreed indemnity payment to insured beneficiaries whenever the data source indicates that the index reaches the "strike point," or insurance activation level.

For example, if one is insuring against livestock mortality, then rainfall or forage availability may be suitable indicators if drought or a shortage of forage, or a combination of the two, often result in above-normal livestock mortality. One could then write an insurance contract based on some statistically specified function of a rainfall or forage indicator to protect against specified levels of aggregate livestock losses. The contract would specify its geographical reach, temporal (or seasonal) coverage, the strike level, and the relevant premium and payment terms.

An index-based insurance product has significant advantages over traditional insurance. Traditional insurance requires that the insurer monitor the activities of their clients and verify the truth of their claims. For relatively small clients in infrastructure-deficient environments like the northern Kenyan arid and semi-arid lands (ASALs), the costs of such monitoring are often prohibitive. With index-based insurance products, all one has to do is monitor the index, thereby sharply reducing costs. Furthermore, by using an index based on variables that cannot be influenced by any insuree's behavior, index-based insurance products overcome the key asymmetric information problems that plague traditional insurance contracts: that more (less) risk-prone individuals will self-select into (out of) the contract and that insured individuals have an incentive to take on added risk – phenomena known as "adverse selection" and "moral hazard", respectively.

These gains from index-based insurance come at the cost of "basis risk", which refers to the imperfect correlation between

an insuree's potential loss experience and the behavior of the underlying index on which the insurance product payout is based. Individuals can suffer losses specific to them but fail to receive a payout because the index does not trigger. On the other hand, lucky individuals may receive indemnity payments that surpass the value of their losses. While this problem cannot be completely eliminated, we have carefully designed the IBLI contract to minimize basis risk and therefore to maximize its value to the insured population.

Economic and social returns to IBLI for the ASAL

In Kenya's arid and semiarid lands (ASALs), drought is the most pervasive hazard, natural or otherwise, encountered by households on a widespread level. This is especially true for northern Kenya, where more than 3 million pastoralist households are regularly hit by severe droughts. In the past 100 years, northern Kenya recorded 28 major droughts, four of which occurred in the last 10 years. For livelihoods that rely solely or partly on livestock, the resulting high livestock mortality rate has devastating effects, rendering these pastoralists among the most vulnerable populations in Kenya. As the consequences of climate change unfold, the link between drought risk, vulnerability and poverty becomes significantly stronger.

In such an environment, the economic and social returns to an effective program that insures pastoral and agro-pastoral populations against drought-induced livestock losses can be substantial. To the extent that the likelihood of severe herd mortality reduces incentives to build herds, insuring livestock against catastrophic loss would address the high risk of investment in such environments. By thus stabilizing asset accumulation this should improve incentives for households to build their asset base and climb out of poverty, thereby enhancing economic growth.

One of the principle negative effects of a risky environment is that it depresses the development of financial markets that are a critical pillar of economic growth. Private creditors are often hesitant to offer uncollateralized loans particularly when borrowers' capacity to repay is closely tied to risk outcomes. In such an environment, financiers might become willing to lend if the assets that secure their loans could be insured. Livestock insurance, which can be used as collateral, can thereby potentially "crowd-in" much-needed credit for enterprises and individuals in the region without leaving creditors overexposed.

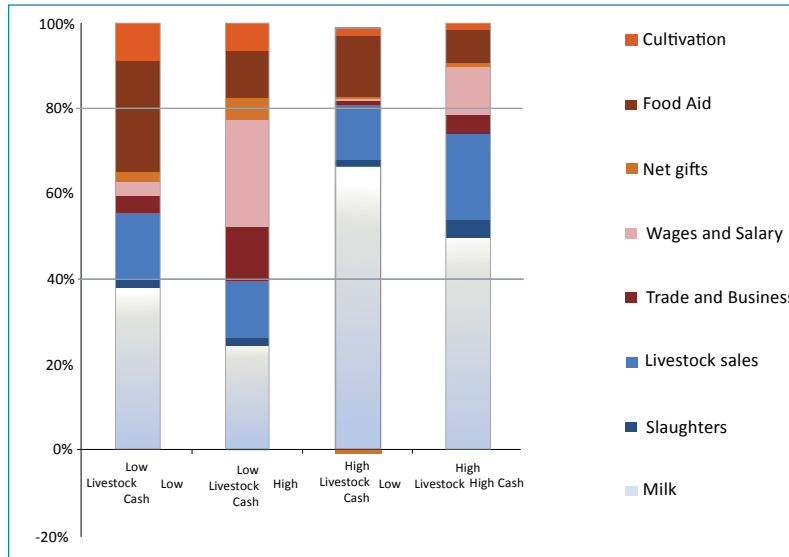
Finally, because it provides indemnity payments after a shock, livestock insurance could help stem the collapse of vulnerable, but presently non-poor households, into the ranks of the poor following a drought (or related crisis) due to irreversible losses from which they do not recover. This is a particularly salient point given the increasing empirical evidence of behavioral response consistent with the presence of dynamic poverty traps among pastoralists of northern Kenya (Barrett and McPeak, 2005; Lybbert et al., 2004; McPeak, 2001; Santos and Barrett, 2006). Poverty traps manifest in the form of a dynamic herd-size threshold above which herds accumulate to a high-level equilibrium and below which herd sizes naturally diminish to a low-level equilibrium below the poverty line. For those with herd sizes slightly above this threshold, protecting them against losses that will naturally lead them toward chronic poverty is an important priority that IBLI could theoretically fill (Barrett et al., 2008; Chantarat et al., 2009b).

IBLI design and implementation challenges

Despite the contractual advantages of an index-based insurance product, as well as the potential economic and social benefits, four major challenges confront the creation of an IBLI contract and ensuring a sustainable market for it:

- High quality data are required to accurately design and price insurance contracts and determine when payouts should be made;
- Design of an optimal insurance index that to the maximum extent possible reduces the risk borne by the target population so that the value and potential demand for the product are high;
- Effective demand for IBLI insurance among a target clientele largely unfamiliar with insurance in general and index-based agricultural insurance in particular; and
- Cost-effective ways of delivering IBLI insurance to small and medium scale producers in remote locations.

Given the promise of IBLI to manage the considerable drought-related mortality risks that pastoral and agro-pastoral populations face and the challenges associated with introducing a novel and relatively complex product to a remote and largely illiterate population, it was necessary to develop a comprehensive research and development agenda that would incorporate the design of a context-specific IBLI contract,



Source: McPeak et al. 2010b

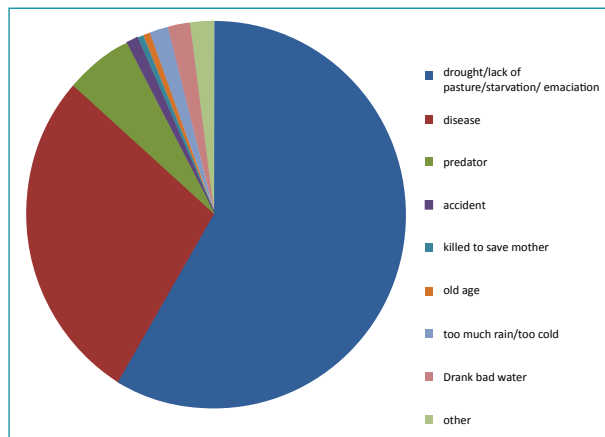
Figure 1: Income sources by livelihood grouping

examine the risk profile of the target population, explain the contract and coverage terms, elicit willingness-to-pay, and create the environment necessary for a successful pilot. The following section highlights some of the key activities undertaken within this agenda.

Developing IBLI for northern Kenya

Overview of the livestock economy in Marsabit District

The value of an IBLI contract for underwriting risks depends on the role that risk plays within the target economy and how amenable it is to indexing. In other words, is it a risk that is largely covariate in nature, impacts a substantial number of the insurable population over a sufficiently wide spatial area, and is highly correlated to a readily observable and cheaply available



Source: McPeak et al. 2010b

Figure 2: Causes of livestock mortality

non-manipulatable variable that can serve as the index? These characteristics, which we sought as a precondition for a suitable pilot location, are found in the livestock economy of Marsabit District in northern Kenya.

Northern Kenya's climate is generally characterized by bimodal rainfall with short rains falling from October through December, followed by a short dry period from January-February, and long rains in March-May, followed by a long dry season from June-September. Pastoralists rely on both rains for water and pasture for their animals, as well as occasional dryland cropping. Pastoralism in the arid and semiarid areas of northern Kenya is nomadic in nature, where herders commonly adapt to spatiotemporal variability in forage and water availability through herd migration.

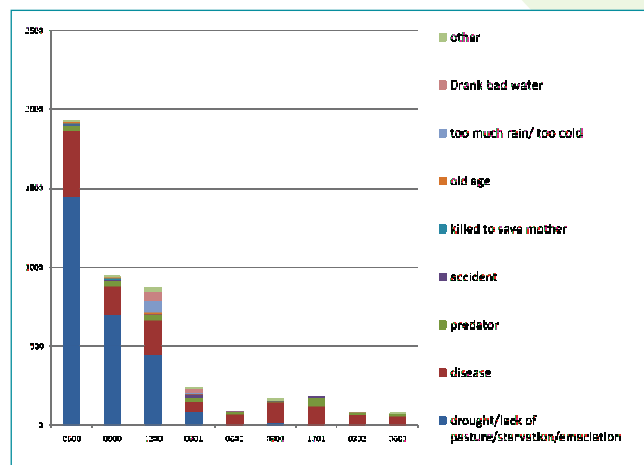


Figure 3: Causes and relative number of livestock losses by season

Livestock represent the key source of livelihood across most ASAL households. As Figure 1 shows, when households are split across four categories – high and low cash income and high and low livestock holdings (where the threshold for high/low is determined by the median value), only the low-livestock, high-cash households obtain less than 50% of their income from livestock.

The danger is that livestock face considerable mortality risk, rendering pastoralist households vulnerable to herd mortality shocks. Among these, drought is by far the greatest cause of mortality (Figure 2) and drought-related deaths largely occur during severe shocks, as during the rain failure of 2000 (Figure 3). IBLI is designed for precisely these instances of considerable loss. During times of relative normalcy, mortality arises relatively randomly due to non-drought related mortality causes such as diseases and predators. Such losses can be self-insured. IBLI is designed to cover those more severe shocks that pose a greater threat to livelihoods.

Design of the IBLI contract

To design and appropriately price the IBLI contract itself, we had to find a measure that is (i) highly correlated with local livestock mortality; (ii) reliably and cheaply available for a wide range of locations; and, (iii) historically available to allow pricing of product. The Normalized Difference Vegetation Index (NDVI) meets these conditions. Constructed from data remotely sensed from satellites, NDVI is an indicator of the level of photosynthetic activity in the vegetation observed in a given location. As livestock in pastoral production systems depend almost entirely on available forage for nutrition, NDVI serves as a strong indicator of the vegetation available for livestock to consume. Since the late 1980s, the United States' NASA and NOAA have used AVHRR data⁸ to produce decadal (10-day) composite NDVI images of Africa at a resolution of 8.0 x 8.0 km a day, and have built a valuable archive of these data from June 1981 to present, which are available in real time and free of charge.⁹

While NDVI has properties that make it reliable as the basis for an insurable index, it must also have value for the insured. In other words, NDVI data has to predict livestock mortality rates reasonably well. We used household-level livestock mortality

data collected monthly since 2000 in various communities in Kenya's ASAL districts by the Government of Kenya's Arid Lands Resource Management Project (ALRMP) to statistically estimate the relationship between NDVI measures and observed livestock mortality. To improve the contract and minimize the expected incidence of basis risk, we used panel data collected by the USAID-funded Pastoral Risk Management (PARIMA) Project quarterly from 2000 to 2002 (See Chantarat et al., 2009a for more details on data and product design).

Our current contract is based on Marsabit District, the pilot area. We combined herd history data to create an optimal insurance index defined as the function of the NDVI data that is simple, replicable, commercially implementable and highly correlated with the herd mortality data so that it provides the maximum possible insurance value to the pastoralist population.

The key feature of the contract we designed is a statistical predictive relationship between average livestock mortality within a specific area and the satellite-based indicator of forage availability NDVI. Equation (1) presents a simplified version of the regression model we estimate to generate the key relationship underlying the IBLI contract¹⁰. The area average livestock mortality rate, M_k , can be decomposed into the systematic risk associated with the vegetation index and the risk driven by other factors:

$$(1) M_{ls} = M(X(ndvi_{ls})) + \epsilon_{ls}$$

where $ndvi_{ls}$ represents various transformations of the average NDVI observed over season s in location l . These transformations include standardized NDVI that presents deviations from the long-term average and also include cumulative standardized NDVI summed across various periods across the seasons prior to coverage. These transformations are intended to capture the unique dynamics of the pastoral production system whereby the nutritional health of livestock is not only dependent on current forage conditions but also the state of forage over the past couple of seasons. $M(\cdot)$ represents the statistically predicted relationship between $X(ndvi_k)$ and M_k , and $E(\cdot)$ is the mean zero, serially uncorrelated idiosyncratic component of area average mortality that is not explained by $X(ndvi_k)$ – i.e., location-specific basis risk. We predict area average mortality

⁸The NDVI data we use is derived from data collected by National Oceanic and Atmospheric Administration (NOAA) satellites, and processed by the Global Inventory Monitoring and Modeling Studies group (GIMMS) at the National Aeronautics and Space Administration (NASA). The NOAA-Advanced Very High Resolution Radiometer (AVHRR) collects the data used to produce NDVI. Values of NDVI for vegetated land generally range from about 0.1 to 0.7, with values greater than 0.5 indicating dense vegetation.

⁹Further details about NDVI are available at <http://earlywarning.usgs.gov/adds/readme.php?symbol=nd>.

¹⁰We present the modeled contract in simplified form and do not delve deeply into the key design issues. For a more detailed technical description and analysis, please see Chantarat et al. (2009a).

Table 1: Insurance contract performance

Cluster	Strike	Correct trigger decision	Incorrect decision	
			Type 1 error	Type 2 error
Chalbi	10%	0.71	0.13	0.17
	15%	0.81	0.06	0.13
	20%	0.88	0.04	0.08
	25%	0.85	0.10	0.04
	30%	0.94	0.04	0.02
Laisamis	10%	0.80	0.09	0.11
	15%	0.88	0.03	0.09
	20%	0.84	0.09	0.06
	25%	0.81	0.14	0.05
	30%	0.84	0.13	0.03

from observations of $ndvi_k$, specific to each location l and season s , as:

$$(2) \quad \hat{M}_k = M(X(ndvi_k))$$

The response function represented by Equation (2) serves as the underlying index for the insurance contract.

As livestock mortality response to forage can vary due to different factors, it was necessary to divide Marsabit District into two clusters, each distinguished by its own response function, in order to improve precision of contracts. The two distinct geographic zones (Figure 4), which we term the Laisamis Cluster and the Chalbi Cluster were divided based on statistical cluster analysis, which bundles locations with similar characteristics, such as distribution of species within a herd, mortality rates and variables that may influence the predictive relationship between livestock mortality and NDVI. The Chalbi cluster is drier and its herds have a higher fraction of camels and smallstock while in Laisamis cattle dominate.

The performance of the contracts can be analyzed by looking at how well the predicted mortality index corresponds to the actual area-averaged mortality in the target area. We present these results for both clusters and various insurance triggers in Table 1. Predictive relationships for both clusters maintain a high probability of correct trigger decisions. We define a correct decision as occurring when the model predicts mortality rates above the trigger and actual data shows that indeed mortality rates were above the trigger level. Correct decisions are also made when the model fails to trigger and actual mortality also did not register above the trigger. Where errors occur, they are

quite well distributed between Type 1 (when beyond-strike loss is experienced but no payout is triggered) and Type 2 (payout is triggered when experienced loss is below the relevant strike) errors – the two components of basis risk. It is clear, however that contract performance generally improves the higher the strike. A balance must therefore be made between contracts that optimize performance and ones that covers a wider range of risk.

With the response function estimated, we then estimate the actuarially fair premium rate per season per value of Tropical Livestock Unit (TLU) livestock insured for location l in season s covering the loss event that the predicted area averaged mortality index \hat{M}_k is beyond the mortality strike of M_l^* can be written as:

$$(3) \quad p_k(M_l^*) = E(\text{Max}(\hat{M}_k - M_l^*, 0))$$

where $E(\cdot)$ is the expectation operator over a distribution of NDVI based mortality index. The mortality strike M_l^* is the mortality level for location l , additional losses beyond which the contract will compensate for. The simplified pricing equation presented in Equation (3) above is the actuarially fair premium rate (%) per value of aggregate livestock insured. Table 2 reports the actuarially fair premium rates for contracts with various strikes across both clusters. Because the incidence of widespread mortality is higher in Chalbi than Laisamis, the fair premium rates are likewise higher there. As expected, the lower the strike level beyond which indemnity payments are triggered, the higher is the premium as compensation is more likely to occur.

Table 2: Annual actuarially fair premiums for selected strike points across premiums

Cluster/Contract	Premium Rate (% of insured value)			
	10% Strike point	15% Strike Point	20% Strike Point	25% Point
Chalbi Cluster	9%	5%	3%	1%
Laisamis Cluster	5%	3%	1%	1%

Uncovering client interest and demand for IBLI

In order to appropriately understand the target clients' attitudes toward risk, to study their demand for insurance and conduct ex-ante impact assessments, we conducted in-depth community and household-level surveys among pastoralists in five communities in Marsabit District (Dirib Gombo, Karare, Logologo, Kargi and North Horr) chosen purposively to vary in terms of pastoral production system, market access and agroecology. The main objectives of the surveys were to (i) have full understanding of pastoralists' nature of livestock losses, their perceptions about risk of livestock loss and climate; (ii) introduce potential clients to the concept of IBLI; and (iii) investigate patterns and determinants of demand and willingness to pay for IBLI.

After an initial introductory focus group discussion with approximately 15-20 community members, we fielded a household survey in each location in which 42 households per location were randomly drawn using stratified sampling by wealth class. The household survey collected household-level information, production data, risk profiles, the history of herd dynamics, perceptions about risk of livestock loss and other relevant information.

The IBLI experimental game

These households were later brought together to take part in an experimental game designed to replicate existing pastoral production systems, which we used to illustrate how index insurance would work and how it could be beneficial (Lybbert et al., 2010; McPeak et al., 2010a). Experience with other index insurance pilots has shown that a carefully designed program of extension to appropriately educate potential clients is a necessary precondition to both initial uptake and continued engagement with insurance (Gine et al., 2007; Sarris et al., 2006). A prerequisite to generating demand and ensuring that the risk-management benefits of insurance effectively serve the client is for them to clearly understand the value of insurance and, in particular, how an index insurance product works.

In order to design an extension tool that adequately captures the complexities of the IBLI product and relays the key features and

terms of the contract, we took a cue from the growing field of experimental economics. Experimental games offer a method by which complex concepts can be distilled and taught in a relatively simple manner, and dynamic decisions or processes can be easily repeated during game play to mirror the outcomes and elicit the behavioral response that could otherwise take years to understand.

A good experimental game that can impart important insights and lessons onto its "players" needs to ensure that the simplified, abstract game mirrors the real world (in this case the actual features of IBLI contracts and their interaction with the pastoral production system) as much as possible. As such, we designed our IBLI educational game to replicate the nonlinear herd dynamics that livestock keepers in the rangelands face, as well as the basis risk intrinsic to IBLI and state-conditional indemnity payments only when an insurance premium was paid before the season began.

Soliciting willingness-to-pay

The games were very well received and in both their responses and questions in a sessions conducted after the games it was clear that the key intended lessons had been grasped:

- 1) One had to pay for insurance within the period of coverage to qualify for indemnity payments;
- 2) If premiums were paid but the strike to activate insurance was not attained, you were not entitled to your premiums back;
- 3) Payments were a function of area average loss and not individual loss; and
- 4) Loss was determined by forage estimates derived from satellite-generated information.

Nonetheless, while the games are arguably the most effective way to educate clients on the workings on an IBLI contract, they are also expensive to run and may not be cost-effective on a large commercial scale.

Table 3: Percentage of respondents willing to pay at least the stated amount for ILBI by location

Location	10% Strike		30% Strike	
	Fair	Fair +20%	Fair	Fair +20%
Overall	50%	34%	69%	69%
Dirib Gombo	71%	41%	78%	78%
Kargi	46%	32%	50%	50%
Karare	81%	75%	100%	100%
Logologo	30%	14%	57%	57%
North Horr	35%	22%	71%	71%

Table 3 presents the percentage of sampled respondents across locations who had a willingness to pay for IBLI at or above the quoted prices. Two prices were quoted, the actuarially fair price and the fair price with a 20% loading to account for possible mark-up and other business costs that may be associated with commercial provision. On average more than one third of the sample indicated a willingness to pay at least 20% above the fair price for the 10% strike contract, a figure that jumped to almost 70% for a 30% strike contract. One reason the 30% strike contract is likely to be more popular is because it is much cheaper. This also explains the lack of variation between the fair and fair + 20% contracts. At such low costs, an additional 20% is often times trivial.

Commercial contract features and terms - Having established a strong potential demand for IBLI at commercially sustainable prices what remains is to pilot the product. To launch the IBLI

contract on the market five key contract parameters must be clearly set out:

- 1) The geographical area that the contract covers;
- 2) The “premium” or the price paid for insurance coverage;
- 3) The “strike point,” meaning the index level at which the insurance is activated and payouts begin;
- 4) The value that will be paid for each livestock unit that is later estimated to have been lost; and
- 5) The length of time for which paid coverage lasts.

Geographical coverage of contract: Marsabit District will be covered by the two different response functions previously described above (Figure 4). The Chalbi response function underlies the Upper Marsabit contract consisting of Maikona

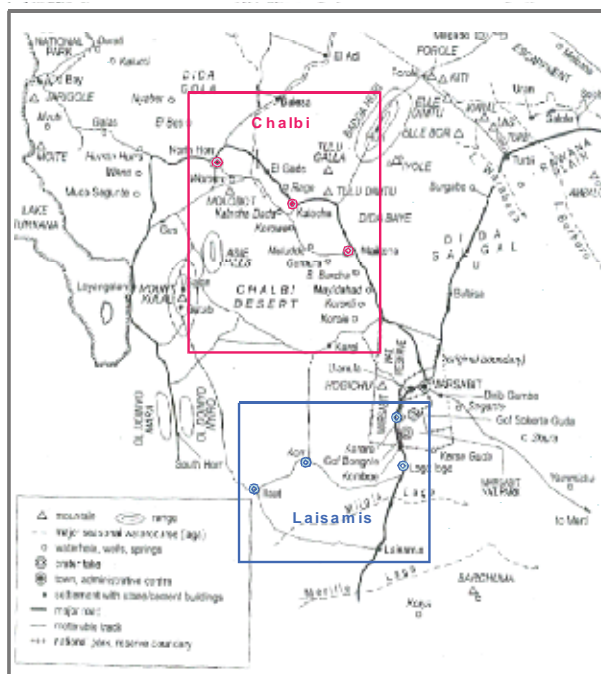


Figure 4. Chalbi and Laisamis contract coverage clusters



Figure 5. Contract spatial coverage

and North Horr divisions, and the Lower Marsabit contract consisting of Central, Gadamoji, Laisamis, and Loiyangalani divisions is based on the Laisamis response function (Figure 5). The boundaries were chosen due to clear agro-ecological and pastoral production system differences, as well as differences in risk. Upper Marsabit has a higher fraction of camels and smallstock in their herds than does Lower Marsabit. While the two contract clusters imply two different prices, premium payouts will be division-specific. Therefore, in the Lower Marsabit cluster for example, there will be three different division-specific livestock mortality predictions for the index upon which premium payouts will be determined.

Annual contract premiums and strike point: For the Marsabit Pilot launched in January of 2010, the relevant premiums as established by the commercial partners are presented in Table 4. These prices are specified for a contract with a strike point at 15%, the chosen trigger level. Fifteen percent was chosen after a process of negotiation among the commercial and technical partners that involved a tradeoff between a lower strike, which

Table 4: IBLI premiums for 15% strike contracts in Marsabit

Contract Cluster	Consumer Price	Total Market Price
Upper Marsabit	5.5%	9.2%
Lower Marsabit	3.25%	5.4%

would provide greater risk coverage but cost more, and a higher strike which, while cheaper, covers a lower portion of the risk. One can think of the strike point as a deductible. Individuals will cover any losses up to 15% predicted mortality and insurance will compensate for any losses above that. The consumer price is the amount the clients in the specified coverage area paid for.¹¹ The actual market price, however, includes the full costs of commercial partner commissions and the relevant taxes. The difference is currently being subsidized by donors. The expectation is that, as the novelty of the product wears off and late-adopters enter the market, increased competition and the market, coupled with greater capacity in the industry, will bring the actual price down to a consumer price that represents a 30% loading on the fair premium on average.

Insurable livestock unit and value of herd: The standard livestock types for a pastoral herd will be covered. These are camel, cattle, sheep and goats. To arrive at a value for the insured herd, the four livestock types will be transformed into a standard livestock unit known as a Tropical Livestock Unit (TLU), where: 1 TLU = 1 cow, 1 TLU = 0.7 camel, 1 TLU = 10 goats and 1 TLU = 10 sheep. Using average prices for livestock across Marsabit and discussion with key traders and stakeholders, we have arrived at a set price per TLU insured of Ksh 15,000.¹²

¹¹Clients do not have to be living in the area for which they purchase coverage. They only have to state that the herd they are insuring largely resides in the coverage area. Nevertheless, for the pilot, clients did not have to provide proof of livestock ownership.

¹²While in theory clients can simply state their subjective valuation of the herd they want to insure, we opted for a standard price for ease of administration. The standard price was derived as a function of household-level livestock sale price data (Chantarat, 2009a).

Temporal structure of contract: Figure 6 presents the time coverage of the IBLI contract being piloted. The contract is an annual one whose coverage spans from March 2010 to February 2011. IBLI contracts (and other Index-based Insurance contracts) can only be purchased within a specific time window, which in this case is in January and February 2010 (and August/September 2010 for contracts spanning October 2010 to September 2011). Contracts must be sold within this time frame as the rainy season beginning right after that may give the potential buyer information about the likely conditions of the season to come that would unfairly affect his purchase decision. This annual contract has two potential payout periods: (i) at the end of the long dry season in September and (ii) at the end of the short dry season in February. At these points in time, if the index reads greater than 15%, insurance will pay clients.

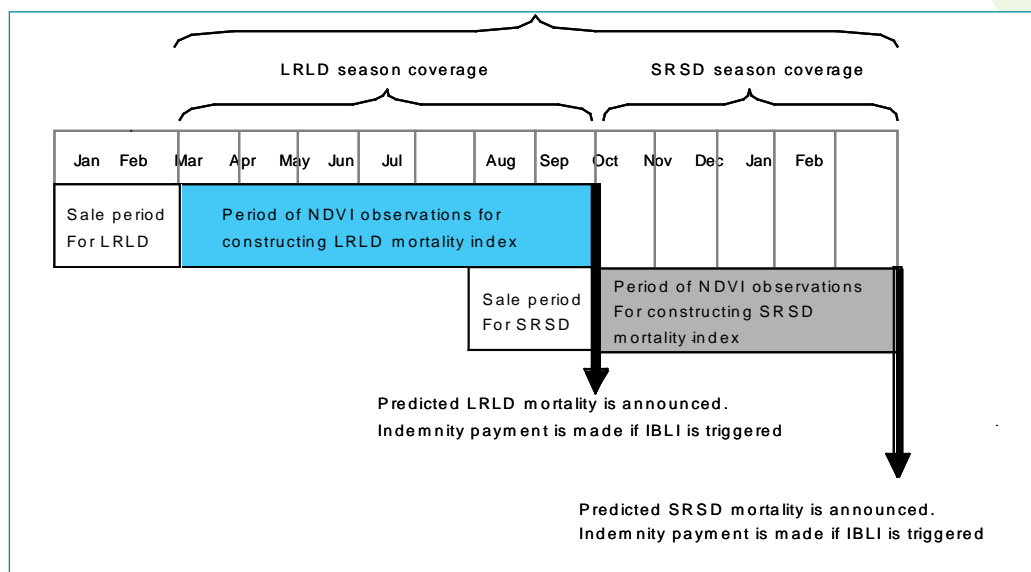
How does IBLI work?: As an example, let us consider the Gudere family in Kargi who purchase 10 tropical livestock units of IBLI insurance for the period covering March 2010 to February 2011. At Ksh 15,000 per TLU, Gudere's herd would be valued at Ksh 150,000 (=15,000 x 10). As Kargi is located in Lower Marsabit, Gudere would pay an annual premium of Ksh 4,875 (which is 3.25% of Ksh 150,000) to cover his entire herd for the annual coverage period. Put in perspective, this is about the value of just over 3 goats to insure 10 cows over the space of a year.

Once Gudere has purchased insurance, he will now wait to see

if he receives any compensation. At the end of September, we would obtain the 2010 long rain/long dry NDVI data for the Laisamis division that Kargi is in and feed those data into the Laisamis response function, generating the predicted mortality index. Suppose the predicted mortality rate is 13%. Gudere would not receive any compensation. However, let us imagine that at the next possible payout period, in February 2011, the predicted mortality for Laisamis at that time is 25%. This 25% mortality index is then compared to the contractually stipulated strike point of 15%. In this example, the Gudere family would receive compensation for 10% (=25%-15%) of their covered herd of 10 livestock units. They would thus receive a payment of KSh 15,000 (= 10% of Ksh 150,000, the insured herd value). All the Gudere's insured neighbors in Laisamis would receive compensation at the same predicted rate of 10% of their insured herds. Those who bought no insurance would receive no indemnity payment.

Launching the IBLI pilot

Critical to the objective of launching a commercially sustainable product was convincing commercial partners to take up the product and offer it through the market. Through a process of broad engagement with potential partners, a tripartite of interested parties collaborated with the International Livestock Research Institute (ILRI) to launch the pilot in Marsabit. UAP Insurance Company of Kenya (UAP), re-insured by Swiss Re



Source: Chantarat et al. 2009.

Figure 6. Temporal structure of IBLI contract

together underwrites the risk while Equity Insurance Agency (EIA), provides the agency services taking care of extension, publicity and sales. ILRI and her research partners (Cornell University, Syracuse University and the University of California-Davis) offer the technical support and provide the evaluation and impact assessment services.

The delivery channel

Marsabit is a remote, sparsely populated and relatively infrastructure deficient area. As such, in thinking through product implementation, one cannot ignore the hardships that may arise in targeting clients, accepting premiums, and making indemnity payments within a system that generates enough confidence to allow for active market mediation. UAP and particularly EIA would need to develop an administrative infrastructure that can cost-effectively contract transactions.

Fortunately, a substantial social protection program, dubbed the Hunger Safety Net Program (HSNP) – funded by the UK Department for International Development (DfID) – began rolling out in four of Kenya’s poorest districts in 2009. Within a year, and for the first four-year phase of its ten-year expected duration, the HSNP plans to deliver regular cash transfers to 60,000 households spread across Mandera, Marsabit, Turkana and Wajir. This is a huge task for which a well-designed delivery channel with a wide network across these regions is required.

The Financial Sector Deepening Trust (FSD), in conjunction with Kenya’s Equity Bank (EIA’s parent firm), has been working on just such a delivery channel and had the responsibility of creating the necessary Information and Communication Technology (ICT) and financial infrastructure needed to support the HSNP program. Equity Bank was contracted to open over 150 new Points of Sale (PoS) across these regions that will be able to facilitate and provide the HSNP cash transfer to recipient households. Using new hi-tech portable devices within a sophisticated computing system, these PoS devices can be easily configured to accept premiums for certain insurance contracts and register indemnity payments when necessary. EIA will use this delivery infrastructure to offer IBLI contracts. Where EIA wants to offer the product in Marsabit communities not selected to receive HSNP cash transfers, it would be easy to extend the network to these areas.

Preparing to launch

An entirely new product requires several layers of preparation for it to be successfully launched into the market. First, any required regulatory authorization must be secured. The partners attained regulatory approval to proceed from the Insurance Regulatory Agency (IRA) of Kenya. The IRA’s main concern was the question of “insurable-risk” whereby the insured party’s covered risk is very clear. We argued that one of the key benefits of an index insurance product that drastically reduces transactions costs was that there was no need for insurance companies to verify actual livestock losses because payments were entirely a function of the index. As such, we recommended that insurance be sold without requiring the agent to verify if the client actually owns all the livestock that they intend to insure. While this means there is no real way to ensure that the client will indeed face the risk that he is insuring against (drought-related livestock mortality), the IRA finally agreed with the caveat that they would further review the issue should the success of the pilot result in more comprehensive scale-out across the country.

The next step was to publicize the product and prepare the extension effort. In an environment such as Marsabit, it is critically important to receive blessings from influential members of the community. As such, we called a workshop of key stakeholders ranging from Government line ministries and NGOs, to local government representatives, community elders and traders, to carefully explain the product features to them, the pilot strategy and the on-going evaluation efforts. Many were already familiar with the product given the earlier research effort in which we had engaged them.

Given the characteristics of the region, publicity is best received by word of mouth and our key client engagement strategy was through interaction with trained extension agents. As such, we held a weeklong training of close to 20 Master Trainers (MTs) selected from among professionals working in relevant capacities or previously associated with the IBLI research process. This was followed by another weeklong training, run together with the MTs, of Village Insurance Promoters (VIPs) who were recruited from the target villages. In addition to supervising the VIPs, MTs were expected to be able to answer any questions relating to the product’s features and the implementation process not only

from clients but also interested partners and institutions. VIPs on the other hand provided the key grassroots extension effort directed at potential clients.

With all this in place, the IBLI product was launched on January 22, 2010 in a colorful ceremony in Marsabit town. The launch was presided over by the CEO of Equity bank and brought together high-ranking officials, including the Minister for Livestock and the local Member of Parliament, as well as the Secretary General of the Supreme Council of Kenyan Muslims who came in to endorse the product. The high-profile event generated significant buzz that travelled by word of mouth to various corners of the district; the launch also attracted the attention of reputable national and international media houses. For the next six weeks, until the end of February when the selling window closed, the MTs and VIPs fanned out to offer their extension services, and sales agents began, for the first time, to sell IBLI to clients across Marsabit District.

Sales and lessons learned

Results from the first IBLI sales in Marsabit went beyond most expectations. In the six weeks of sales after the launch, a total of 1,979 individuals purchased insurance contracts to cover a total of 3908 cattle, 15,826 sheep and goats, and 339 camels. Total premiums collected came up to US\$ 46,597. Table 5 presents the relevant sales statistics by cluster (Upper and Lower Marsabit).

By highlighting the promise and potential of IBLI in the area, this result has reinvigorated the commercial partners who are already beginning to think of scaling-up the pilot beyond Marsabit District. It is instructive to note that underlying the high level of sales was an often sub-par implementation effort, discussed in some detail below, that was fraught with challenges. Indeed, had the sales delivery process gone as planned, we estimate that we could have sold, at the very least, twice as many contract as we did.

After the sales window ended on February 28, the project team returned to Marsabit in mid-March and brought together various key stakeholders, ranging from a select group of Master Trainers and Village Insurance Promoters, some of the clients that had purchased insurance, village-level government representatives, as well as officials of Government line ministries and heads of local NGOs. The objective was to reflect on the successes and failures of the implementation process, gather perceptions on the product and solicit information to help improve the extension and sales effort for the subsequent sales period. The workshop was held against the backdrop of heavy rains that occurred in the first two weeks of March, resulting in vigorous vegetation response and reducing the likelihood of an insurance payout in September.

The workshop was extremely insightful, generating helpful discussion and highlighting both the key opportunities that must be tapped and the challenges that need to be addressed. Some of the more important issues raised include:

- **A flawed sales process:** The major concern, largely voiced by the Master Trainers and Village Insurance Promoters, was that a failure in the sales delivery system dampened sales and left many interested clients frustrated. As it happened, the software needed to allow the PoS terminals to transact sales of IBLI was not ready on time and thus sales had to be done manually, with agents being driven from town to town to carry out the transactions. With the poor roads and communications infrastructure in Marsabit District and the long distances that had to be covered, this proved to be a real challenge. Some towns could be visited only once or twice during the six-week sales window, often coming in unannounced before the VIPs could rally together interested clients. Consequently, there were many clients who expressed strong interest but were unable to be served, at certain points even getting frustrated and losing confidence in the product. Fortunately the software will be ready in time

Table 5. IBLI Contract Sales Figures for Jan/Feb 2010

	Premium rate	Contracts sold	Cattle no. insured	Sheep/ goats no. insured	Camels no. insured	Total value of insured livestock (USD)	Total value of collected premiums (USD)
Upper	5.5%	556	371	11,081	185	347,620	19,119
Lower	3.25%	1,423	3537	4,745	154	845,460	27,477
Total		1,979	3908	15,826	339	1,193,080	46,597

for the next selling period in September. However, as the PoS terminals may not completely cover the whole District, a clear logistical plan to ensure that all interested clients are served in a cost-effective manner will need to be put in place.

- **Publicity should be improved:** It was noted that, in certain places, individuals were not aware of the product and that the best way to improve awareness and knowledge of the program was by ensuring that the area chief was informed. Radio programming on vernacular stations was also encouraged.
- **Payout trigger too high:** There was also the feeling that a 15% payout trigger level was too high and that it should be lowered to 10% where payments would be made more frequently and cover more of the loss. There was no real conclusion when it was made clear that a reduced trigger level would mean higher prices. However, it is an important issue to consider, as relatively minute indemnity payments made infrequently may begin to erode confidence in the product.
- **Lack of payout may affect demand:** Indications, due to the heavy rains, that the contract would not payout in September left several worried that without a payout in the near future, demand for the product would be severely affected. While this may be true, there were also several among those who had purchased contracts who were relieved that there was rain but recognized that, as drought was inevitable, IBLI would continue to have value. Nevertheless, what the actual impact of continued non-payout will be remains to be seen. However, it is clear that ensuring clients have a solid understanding of how the IBLI product works is critical. The extension message needs to be tweaked to emphasize the downside risk-protection role that IBLI pays.

Conclusion

The effort to design and pilot IBLI as a commercially sustainable tool to help the pastoralists of northern Kenya insure themselves against drought-related livestock mortality has largely been a success. It was a process that began with the identification of the key source of vulnerability plaguing pastoralists and the recognition that IBLI may be a promising intervention to

help manage the main source of risk they face – widespread livestock losses due to drought. What followed was an effort to investigate the feasibility of developing an IBLI product. Marsabit District, where the first IBLI contracts were sold, met all the necessary prerequisites for development: the data needed to model IBLI were available, harsh droughts were established as the leading cause of livestock mortality in an area where livestock formed the backbone of livelihoods, research identified the likelihood of demand capable of supporting a market mediated product, and the delivery infrastructure for the provision of the contracts was already in place.

The relatively high sales generated from the first sale window are a promising sign, but it is still too early to reach a definitive verdict and there are several challenges still to surmount. Nevertheless the train has left the station and is moving fast. Growing interest from both commercial and development partners demands that we aim to rapidly scale up the project to other ASAL districts in Kenya and investigate the feasibility and applicability of IBLI in similar contexts in other countries and regions. We do, however, need to firmly ensure that we can walk before we run. A careful effort evaluating the process and product and rigorously assessing its impacts across various welfare indicators is critical. To this end a comprehensive baseline survey of over 900 households across 16 Marsabit communities was undertaken in September and October 2009. These households will be revisited annually over three years, generating information needed to understand just how well IBLI works as a risk-management tool, as well as the indirect effects it has on household wealth and welfare.

References

- Barrett, C.B. and J.G. McPeak. 2005. "Poverty Traps and Safety Nets." In: *Poverty, Inequality, and Development: Essays in Honor of Erik Thorbecke*. A. de Janvry and R. Kanbur (eds.). Norwell MA: Kluwer Academic Publishers.
- Barrett, C.B., M.R. Carter and P.D. Little (eds.). 2007a. *Understanding and Reducing Persistent Poverty in Africa*. Routledge. London.
- Barrett, C.B., J.B. Barnett, M.R. Carter, S. Chantarat, J.W. Hansen, A.G. Mude, D.E. Osgood, R.J. Skees, C.G. Turvey and M. Neil Ward. 2007b. "Poverty Traps and Climate Risk: Limitations and Opportunities of Index-Based Risk Financing." IRI Technical Report No. 07-02.
- Barrett, C.B., M.R. Carter and M. Ikegami. 2008. "Poverty Traps and Social Protection." Working Paper. Cornell University.

- Chantarat, S., A. Mude, C.B. Barrett and M.R. Carter. 2009a. "Designing Index Based Livestock Insurance for Managing Drought-Related Livestock Asset Risk in Northern Kenya." Working Paper. Cornell University.
- Chantarat, S., A. Mude, C.B. Barrett and C. Turvey. 2009b. "Effectiveness of Index Based Livestock Insurance for Managing Asset Risk and Improving Welfare Dynamics in Northern Kenya." Working Paper. Cornell University.
- Chantarat, S., A. Mude and C.B. Barrett. 2009c. "Willingness to Pay for Index Based Livestock Insurance: Results From A Field Experiment In Northern Kenya." Working Paper. Cornell University.
- Gine, X., R. Townsend and J. Vickery. 2008. "Patterns of Rainfall Insurance Participation in Rural India." *The World Bank Economic Review* 22 (3): 539-566
- Hellmuth, M.E., A. Moorhead, D.E. Thompson and J. Williams (eds.). 2007. "Climate Risk Management in Africa: Learning from Practice." *Climate and Society* No. 1. International Research Institute for Climate and Society (IRI). Columbia University. New York.
- Hellmuth, M.E., D.E. Osgood, U. Hess, A. Moorhead and H. Bhojwani (eds.). 2009. "Index Insurance and Climate Risk: Prospects for development and disaster management." *Climate and Society* No. 2. International Research Institute for Climate and Society (IRI). Columbia University. New York.
- IFRCRC (International Federation of Red Cross and Red Crescent Societies). 2004. *World Disaster Report 2004*. Kumarian Press, Inc. Bloomfield, CT.
- Intergovernmental Panel on Climate Change (IPCC). 2007. *Climate Change 2007 – Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the IPCC*.
- Lybbert, T.J., C.B. Barrett, S. Desta and D.L. Coppock. 2004. "Stochastic Wealth Dynamics and Risk Management among a Poor Population." *The Economic Journal* 114: 750-777.
- Lybbert, T.J., F. Galarza, J. McPeak, C.B. Barrett, S. Boucher, M.R. Carter, S. Chantarat, A. Fadlaoui and A.G. Mude. 2010. "Dynamic Field Experiments in Development Economics; Risk Valuation in Morocco, Kenya and Peru." *Agricultural and Resource Economics Review*, forthcoming.
- McPeak, J. and C.B. Barrett. 2001. "Differential Risk Exposure and Stochastic Poverty Traps among East African Pastoralists." *American Journal of Agricultural Economics* 83: 674-679.
- McPeak, J., S. Chantarat and A.G. Mude. 2010a. "Explaining Index Based Livestock Insurance to Pastoralists." Syracuse University Working Paper.
- McPeak, J., P.I. Little and C. Doss. 2010b. *Livelihoods in a Risky Environment: Development and Change among East African Pastoralists*. Forthcoming in Routledge Press. London.
- Santos, P. and C.B. Barrett. 2006. "Heterogeneous Wealth Dynamics: On the Roles of Risk and Ability." Working Paper. Cornell University.
- Sarris, A., P. Karfakis and L. Christiaensen. 2006. "Producer demand and welfare benefits of rainfall insurance in Tanzania." *FAO Commodity and Trade Policy Research Working Paper No. 18*.
- Skees, J.R. and B. Collier. 2008. "The Potential of Weather Index Insurance for Spurring a Green Revolution in Africa." *Global Ag Risk Inc*.
- Skees, J. R., J. Hartell and J. Hao. 2006. "Weather and Indexed-based Insurance for Developing Countries: Experience and Possibilities." In: *Agricultural Commodity Markets and Trade: New Approaches to Analyzing Market Structure and Instability*. A. Sarris and D. Hallam (eds.). Edward Elgar Publishing, Ltd. (for the Food and Agriculture Organization of the United Nations). Cheltenham UK and Northampton MA.
- Tebaldi, C., et al. 2006. "Going to the Extremes: An Intercomparison of Model-Simulated Historical and Future Changes in Extreme Events." *Climatic Change* 79: 185-211.
- Thornton, P., P. Jones, T. Owiyo, R. Kruska, M. Herrero, V. Orindi, S. Bhadwal, P. Kristjanson, A. Notenbaert, N. Bekele and A. Omolo. 2008. "Climate Change and Poverty in Africa: Mapping Hotspots of Vulnerability." *African Journal of Agricultural and Resource Economics* (2).
- World Bank. 2005a. "Managing Agricultural Production Risk: Innovations in Developing Countries." Agriculture and Rural Development Department. The World Bank. Washington DC.
- World Bank. 2005b. "Livestock Mortality and Vulnerability to Poverty among Mongolia's Herder Households: A Policy Note." Poverty Reduction and Economic Management Department, East Asia and Pacific Region. June, 2005. The World Bank. Washington DC.
- World Bank. 2005. "Managing Agricultural Production Risk: Innovations in Developing Countries." Office of the Publisher. The World Bank. Washington DC.

Smallholder based market information and linkage system: The case of Kenya Agricultural Commodity Exchange – impacts, lessons and challenges

A.W. Mukhebi¹, J. Kundu², A. Okolla² and W. Ochieng²

Abstract

This paper describes a market information and linkage system (MILS) developed by the Kenya Agricultural Commodity Exchange Limited (KACE) designed to provide reliable and timely market information targeting smallholder farmers and to link the farmers to better input and output markets. The MILS involves harnessing modern information and communication technologies (ICTs) to enhance the bargaining power of the farmer for a better price in the market place.

The components of the KACE MILS, which are platforms for market information delivery and market linkage, are: Market Resource Centers (MRCs), which are information kiosks in rural markets; Mobile Phone Short Messaging Service (SMS); Interactive Voice Response Service (IVRS), which uses voice mail; an Internet Database System (IDS), which disseminates market information through email messages and a website; National and Rural FM Radio; and the KACE Headquarters Central Hub (KHCH) in Nairobi, which provides system coordination.

A recent study of the impact of the KACE MILS concluded that the proportion of farmers and traders that say their incomes have increased and their bargaining positions have improved is very high (75% farmers and 60% commodity traders). This is attributed to improved bargaining power by farmers for better prices, as well as linkages to better markets. Furthermore, the study concluded that it was clear that, during the years in which the KACE MILS has been operational, market integration improved as evidenced by the narrowing of spatial and temporal price differences among markets for two commodities studied (maize and beans).

KACE has learned a number of lessons from the experience of developing and applying the MILS. These include the observation that farmers and agribusinesses in rural areas are willing and able to pay for additional marketing services beyond market information for more effective linkage to input and output markets. This influenced KACE's decision to pilot the franchise model for MRCs to offer a wider range of demand-driven services, beyond just market information. Another main lesson is that ICTs have a critical role to play in enabling poor

smallholder farmers in remote rural areas to access input and output markets. This is shown by a research study finding that 75% of farmers that used KACE MILS reported that their incomes and bargaining positions had improved.

Some of the challenges KACE has faced include: relatively high costs of mobile phone calls, SMS and IVRS to users; ICT illiteracy among smallholder farmers; small quantities of produce of varying quality offered by smallholder farmers (lack of bulking); and limited KACE human and financial capacity to scale-out and scale-up the MILS. These challenges limit ICT use and market access by farmers or greatly increase their transaction costs.

KACE's future plans include scaling up and out the MILS through the franchise model, and forging alliances with other emerging commodity exchanges in eastern and southern Africa to exchange market information and facilitate regional agricultural trade. These activities will significantly expand market access for smallholder farmers, while at the same time help to improve revenue generation for long-term financial sustainability of the MILS.

Background

Agricultural markets in Kenya – and indeed in Africa – do not work efficiently for poor smallholder farmers (Adesina, 2004). Following the market liberalization reforms undertaken by the Government of Kenya in the late 1980s and early 1990s, agricultural markets are characterized by the following constraints, among others:

- Long chains of transaction between the farmer and the consumer;
- Poor access to reliable and timely market information;
- Small volumes of products of highly varied quality offered by individual smallholder farmers; and
- Poorly structured and inefficient markets.

The lack of market information represents a significant impediment to market access especially for smallholder poor farmers; it substantially increases transaction costs and reduces market efficiency. For any one commodity, the value chain consists of multiple actors, each taking a margin at every stage of

¹KACE Founder and Chairman. Corresponding author (amukhebi@kacekenya.co.ke).

²Kenya Agricultural Commodity Exchange Limited, Brick Court Building, 2nd Floor, Mpaka Road, Westlands, P.O. Box 59142-00200, Nairobi, Kenya. Email: kace@kacekenya.co.ke; Website: www.kacekenya.co.ke

the chain, and price variations in space and time are often large and erratic (Adesina, 2004).

Liberalization of agricultural markets has introduced new challenges to farmers, especially poor smallholder farmers. Government marketing boards have either collapsed or can no longer guarantee the farmer a market for his produce. Equally, buyers of commodities from farmers (traders, processors or consumers) do not have sufficient information about commodity sources and prices.

Farmers, especially smallholders, are disadvantaged in the market place without adequate market information. They are vulnerable to exploitation by those who buy their produce, such as traders, who are often better informed about the market.

The objective of this paper is to describe a market information and linkage system (MILS) developed by the Kenya Agricultural Commodity Exchange Limited (KACE) (www.kacekenya.co.ke), and highlight its impacts, lessons and challenges. The aim of MILS is to reduce the market information asymmetry between farmers and those who buy produce from them. This should enhance the bargaining power of the farmer for better prices in the market place.

The KACE market information and linkage system

KACE has developed its MILS since 1997. Through this MILS, KACE collects, updates and provides market information on various crop and livestock products targeting smallholder farmers. Currently, information is collected on 42 commodities, which are classified into cereals, pulses, tubers, vegetables, fruits and livestock; information on farm inputs is also collected. The markets covered are Nairobi, Mombasa, Nakuru, Eldoret, Bungoma, Machakos, Kitale and Chwele, which are the main agricultural commodity wholesale markets in the country.

The market information collected includes daily wholesale buying prices, as well as commodity offers to sell and bids to buy. KACE also links farmers to markets through matching commodity offers and bids. Market information enhances the bargaining power of the farmer for a better price in the market place, and helps to link the farmer to markets more efficiently.

Components of the KACE MILS

The KACE MILS involves harnessing the power and advantages of modern information and communication technologies (ICTs) for information collection, processing and delivery. The components or platforms of the KACE MILS are:

- Market Resource Centres (MRCs)³;
- Mobile Phone Short Messaging Service (SMS);
- Interactive Voice Response Service (IVRS);
- An Internet Database System (IDS);
- National radio;
- Rural FM radio; and
- The KACE Headquarters Central Hub (KHCH) in Nairobi.

KACE Market Resource Centres – MRCs are information kiosks owned by KACE. They are located in rural markets and serve as sources of KACE market information. They also provide market linkage through matching commodity offers and bids. There are eight MRCs located in the Western, Rift Valley and Eastern Provinces of Kenya.

These MRCs were established by KACE between 1997 and 1999. A typical MRC is a simple one- or two-room leased facility, manned by two KACE staff – a manager and an assistant. It is often equipped with a computer with Internet connectivity, mobile phones, a weighing scale, a moisture meter, and bulletin boards for market information display.

Every morning between 5:00 and 7:00, when wholesale markets are most active, MRC staff visit the wholesale market in their location to collect wholesale buying price data for commodities being traded in the market on that particular day, using a standard procedure agreed upon by all MRCs and KACE Headquarters. Each MRC sends the data to the KACE Central Hub by mobile phone SMS or email, where it is verified and summarized before it is disseminated using the MILS platforms.

The MRC staff use Internet to download summarized information from the Central Hub in Nairobi to display on bulletin boards. They use mobile phones to communicate market information to the KACE headquarters, and also to train farmers on how to

³MRCs were formerly known as rural based Market Information Points (MIPs) and district based Market Information Centres (MICs). MRCs offer a wider range of marketing services beyond agricultural market information, such as storage, weighing, quality testing, etc.

use mobile phones to access KACE market information. Farmers and traders alike use the weighing scales to ascertain produce weights, and the moisture meters to ascertain grain moisture content, both at a small fee to the MRC.

MRC users, mostly farmers and commodity traders, visit to obtain market information and other services at small fees. To obtain commodity market prices placed on bulletin boards is free. However, to place an offer or a bid on a bulletin or trading board for matching costs, a modest placement fee of KSh 100 (~US\$ 1.33) is charged; a further commission is negotiated on successful transactions (usually between 0.5% and 5% of the value of the transaction). The MRC staff charge modest variable fees for weighing, moisture testing and other services that the MRC may offer to clients.

For long-term financial sustainability, KACE is piloting a franchising model for the MRCs, where they can develop and broker a wider range of demand driven services, e.g., transport, storage, input supply, product bulking and quality control. Four MRCs were franchised in 2007. However, three of them were seriously vandalized during the post-national election violence in 2008. The one that survived, located in Chwele Market in Bungoma Central District, western Kenya, continues to thrive and is currently financially self-sustaining; its revenues more than cover its total operational costs.

KACE Short Messaging Service – KACE uses SMS for delivery of market information, especially price information. The SMS is provided in partnership with both Safaricom Limited and Zain Network, the two leading mobile phone service operators in Kenya. The SMS with Safaricom was developed in 2003, with only five commodities covered: maize, beans, cabbages, tomatoes and potatoes. However, with effect from 1 October 2009, the SMS platform was reprogrammed to increase the number of commodities covered – up from 5 to 20 – and was also introduced on Zain Network. The 20 commodities are categorized as follows: **cereals:** maize, rice, sorghum and millet; **pulses:** beans, soybeans, red grounds and green grams; **fresh produce:** cabbages, tomatoes, potatoes and bananas; **livestock:** beef steer, goat, chicken-broilers and eggs; and **farm inputs:** DAP fertilizer, CAN fertilizer, urea fertilizer and maize seeds.

The KACE Central Hub uploads the current information onto the mobile phone networks daily, and subscribers use their handsets to download the information as SMS messages. The charge to

the user per SMS is KSh 7 by Safaricom and KSh 10 by Zain. Both Safaricom and Zain track the number of SMS messages on a monthly basis, and pay KACE an agreed percentage of the net value per SMS message. Currently, the average number of SMS messages per month is about 40,000 for Safaricom and 10,000 for Zain (a newer service).

KACE Interactive Voice Response Service – KACE uses the IVRS to deliver market information on the 20 commodities also covered by the SMS. As with the SMS, the initial IVRS in 2003 covered only 5 commodities, but has now been reprogrammed in March 2010 to cover all 20. KACE submits updated market information daily to the IVRS service provider, the Adtel Phone Company Limited in Nairobi. The company translates the information into voice mail. A user dials a dedicated phone number to access the information through simple menu steps, with a choice of language (Kiswahili or English).

Any mobile phone regardless of network can be used to dial the special number to access the information. Each IVRS phone call is charged a premium rate of KSh 10. Adtel tracks the number of IVRS calls in a month, and pays KACE an agreed percentage of the net value of each call. This IVRS service with Adtel is fairly new and has yet to be promoted for widespread use. The initial 2003 IVRS was with a different service provider who used to charge KSh 20 per call. Due to its relatively high cost per call, the average number of IVRS calls per month was only about 1,000. It is expected that, when promoted, the current expanded and lower cost IVRS will attract more calls.

KACE Internet Database System – KACE disseminates updated market price information through an Internet-based electronic database (RECOTIS) and website (www.kacekenya.co.ke). User email contact addresses are in an electronic database. Updated market information is sent daily to recipients in the database as email messages in an Excel worksheet attachment. Information on 42 crop and livestock commodities is sent. There are currently about six hundred recipients in the database from 26 countries, most of them in Africa. Recipients pay KACE a subscription fee of US\$ 65 for six months or US\$ 125 for 12 months.

National radio – Since 1997, KACE has been submitting updated price information daily to the Kenya Broadcasting Corporation (KBC) Radio (the national radio service) for dissemination. KBC broadcasts the information twice each day – once in the morning and once in the evening – and acknowledges KACE in

the broadcast as the source. However, due to the time constraint on the radio, KBC broadcasts prices for only a few main commodities, usually four to five. The KBC radio network covers the whole country, including remote rural areas, and is therefore widely listened to by the public. KBC estimates that about 5 million people listen to KACE price information broadcast daily. KACE does not receive any revenue from this service, which it contributes as a public good.

Rural FM radio – In 2006, KACE, in collaboration with West Media Limited (WML), proprietors of the West FM Radio Station located in Bungoma town in Western Province of Kenya, established an interactive radio program branded Soko Hewani (“The Supermarket On Air”). Soko Hewani is in effect a virtual trading floor, with KACE using WML’s West FM Radio to match commodity offers and bids made by farmers as well as other commodity sellers and buyers. KACE provides the content of the radio program (verified offers, bids and prices), while WML provides the radio platform, and the design, production and management of the program. Soko Hewani is broadcasted once a week on Tuesday evenings, at a time recommended by WML as a prime time for farmer listeners in the broadcast catchment zone. The catchment zone, with a radius of 200 km, covers Western, parts of Nyanza and parts of Rift Valley Provinces of Kenya and eastern Uganda, a region of an estimated 5 million inhabitants, most of whom are smallholder farmers.

KACE MRCs act as agents to trade through Soko Hewani on their own account or on the account of clients who are mostly smallholder farmers and small-scale commodity traders in accordance with rules and regulations established by KACE. Clients visit MRCs to make offers to sell or bids to buy commodities, by providing information about the quantity of the product for sale or required for purchase, quality, expected price, where the commodity is available or required, the validity period, and the contact address of the client. The MRCs verify offers or bids with respect to the availability, location, quantity and quality of commodities, often by making a physical visit to the client’s premises in case of offers. The MRCs submit verified offers and bids to the KACE Soko Hewani program manager via phone, fax, SMS or email.

The KACE Soko Hewani program manager further verifies, compiles and registers the offers and bids for trading through Soko Hewani. The manager then goes to the West FM Radio studio with the registered offers and bids for trading.

The offers and bids are announced on Soko Hewani. Listeners are given an opportunity to phone or send SMS messages into the radio program and bid on the offers, or offer on the bids. The KACE radio program staff who are on standby during the Soko Hewani broadcast then match the offers and bids, using mobile phone calls and SMSs, or reference back to the specific MRC which submitted the offer or bid for further negotiation and conclusion of deals.

KACE charges a placement fee per initial offer or bid (US\$ 1.50 to US\$ 15, depending on volume), and a modest commission (between 0.5% and 5% of the value of the transaction) on successful transactions concluded through Soko Hewani. The KACE Soko Hewani program standby staff provide listeners with further information about the offers and bids, e.g., the location of buyer/seller, contact information, price negotiation, transport availability, payment terms, etc. MRCs broker (for a negotiable fee) complementary services to facilitate sales transactions, such as quality testing/control, packaging, storage and transportation.

The KACE Headquarter Central Hub – The Central Hub at the KACE Headquarters in Nairobi serves as the nerve center of the MILS. The Hub receives, processes, manages, updates, disseminates and coordinates market information services through the MILS, using the platforms described above: MRCs, SMS, IVR, Internet and radio.

The Hub consists of a Server, wireless Internet connectivity, and several PCs linked in a LAN for fast and timely receipt, processing and dissemination of market information by the KACE information technology staff.

In addition, the KACE Hub undertakes activities aimed at building the capacity of farmers and agribusinesses to access and use MILS services more effectively. These include organizing, often in conjunction with other local service providers, training workshops, exhibitions, field days and promotional road shows. The Hub also promotes the MILS through such activities as publication and distribution of brochures and fliers, participation in agricultural shows and trade fairs, and radio programs.

Sustainability of the KACE MILS

KACE has adopted a business approach to the provision of its services for long-term financial sustainability: clients pay moderate fees for the services received. When the services have been scaled out across the country and many more clients

are accessing and using them, it is projected that the revenues generated will more than cover the costs of providing them.

A summary of KACE's revenue sources described above:

- SMS revenue share from the Safaricom Limited and Zain Network;
- IVRS revenue share from the Adtel Phone Company;
- Placement fees for offers and bids;
- Negotiated commissions from trade linkages; and
- Subscription fees for information through the Internet.

Negotiated commissions on successful offer/bid matches generate the bulk (94%) of KACE's revenue.

KACE MILS impacts, lessons and challenges

Impacts

By providing reliable and timely market information and market linkage services targeted at smallholder farmers, the KACE MILS is expected to improve the efficiency of agricultural markets, and enhance the bargaining power of smallholder farmers in the market place for better prices, resulting in higher farm-gate prices and farm incomes. With higher incomes, farmers will be able to invest in modern technologies to increase productivity. With higher productivity at better prices, smallholder farmers will further increase their incomes, thus experiencing a spiral of wealth creation and escaping the vicious cycle of poverty in which they currently find themselves trapped. This hypothesis and outcome have yet to be tested and assessed, and will take time to occur.

Meuleman (2007), in a study of the impact of the KACE market information system, concluded that the proportion of farmers and traders who have used the system that say their incomes have increased and their bargaining positions have improved is very high (75% farmers and 60% commodity traders). Furthermore, Meuleman concluded it was clear that, during the years in which the KACE MILS has been operational, market integration has improved for the two commodities studied (maize and beans).

Some KACE activities in farmer capacity building for market access have been institutionalized into the Agribusiness Training Centre at the Cooperative College of Kenya, with KACE as one of

the founding members. In addition, KACE is one of the founders of the Eastern Africa Grain Council (www.eagc.org), established to develop and promote a more structured system of marketing cereal grains in the East African Community (EAC).

KACE accepts students taking agricultural marketing courses for short-term field attachment and graduate thesis research from training colleges and universities in Kenya and elsewhere. Furthermore, KACE is a source of time series data on commodity prices in Kenya, required for research and agricultural policy analysis.

One of the important impacts of KACE is that clients in other countries in eastern (e.g., Uganda and Ethiopia), southern (e.g., Malawi) and western (e.g., Ghana and Nigeria) Africa have successfully adapted or adopted the KACE MILS model. The Uganda Commodity Exchange (UCE) (www.uce.co.ug), Ethiopia Commodity Exchange (ECX) (www.ecx.com.et), Malawi Agricultural Commodity Exchange (MACE) (www.ideaasmis.com), Abuja Securities and Commodity Exchange (ASCE) (www.abujacomex.com), and the Network of Market Information Systems for West African States (MISTOWA) (www.mistowa.org) based in Ghana, have all come about with the help of consultancies, visits and learning from KACE.

The social entrepreneurship work of KACE in addressing the plight of poor smallholder farmers for better market access has been recognized globally and continentally by the awarding of the Ashoka Fellowship (www.ashoka.org) in 2005 and the African Association of Agricultural Economists' Fellowship in 2007 to KACE's Founder and Chairman, Dr. Adrian Mukhebi.

Lessons

KACE has learned a number of lessons from the experience of developing and applying its MILS, including:

- In a study of MRCs, Asaba et al. (2005) found that farmers and agribusinesses in rural areas are willing and able to pay for additional marketing services beyond market information for more effective linkage to input and output markets. These services include commodity grading, storage, transportation, short-term credit (for example to hire transport to market), timely access to inputs (and at affordable prices), document preparation and such e-services as email. This influenced KACE's decision to pilot the franchise model for MRCs to develop and offer a wider range of demand-driven services beyond just

market information. The successful franchised MRC at Chwele Market in Bungoma Central District, western Kenya, is demonstrating that franchising holds the potential to develop and offer information and other marketing services in a financially sustainable way.

- ICTs have a critical role to play in enabling poor smallholder farmers in remote rural areas to access input and output markets; however, they must be affordable. The IVRS would seem to be more appropriate than SMS for rural users who may be illiterate, but because the IVRS call (at Ksh 20) costs much more than an SMS (at Ksh 7), the IVRS attracts fewer users per month compared to SMS.
- In a review of KACE in 2005, Tollens (2006) notes that “most market information services in Africa limit themselves to market price information. This is the essence of an MIS. But KACE also has a commodity exchange service through matching offers and bids, which are prominently displayed on blackboards at MRCs, and which are disseminated via SMS and the Internet. This is a big institutional innovation, unheard of until now, and it could really be a major institutional breakthrough in the reform of agricultural markets in Africa.”

Challenges

Some of the challenges KACE has faced include: relatively high costs to users of mobile phone calls, SMS and IVRS; ICT illiteracy among smallholder farmers; small quantities of produce of varying quality offered by smallholder farmers (lack of bulking); limited KACE resource capacity (human and financial) to scale-out and scale-up the KACE MILS; and unfriendly government policies that distort agricultural markets and a plethora of non-tariff barriers that reduce farmers’ interest in marketing agricultural commodities and thus using MILS in the East African Community (EAC) region (World Bank, 2008; EAC Secretariat, 2008). These challenges limit ICT use and market access by farmers, or greatly increase their transaction costs.

Future plans

KACE’s future plans include the following: first, scaling up the Soko Hewani and franchised MRCs from western Kenya to cover other farming areas in the country to enable more smallholder farmers to benefit from the system. Second, actively participating in the bulking of farm inputs and products (including value addition) for farmers in order to access large volume buyers

in domestic and regional markets. Third, forging alliances with other emerging commodity exchanges in eastern and southern Africa, such as the: Ethiopian Commodity Exchange; Uganda Commodity Exchange; Malawi Agricultural Commodity Exchange; African Commodity Exchange (in Malawi); and the Zambia Agricultural Commodity Exchange, in order to exchange market information and facilitate regional agricultural trade. These activities will significantly expand smallholder access to input and output markets, while at the same time help to improve revenue generation for long-term financial sustainability of MILS services. Fourth and finally, KACE would be willing to partner with research or other parties interested in a comprehensive assessment of the impact of its MILS.

Acknowledgements

Initial funding for KACE activities was raised by its directors. However, over time, KACE has accessed additional funding from development partners to whom we are very grateful, including The Rockefeller Foundation, the USAID Mission in Kenya, the Hans Seidel Foundation of Germany, CTA in the Netherlands, and the Alliance for Green Revolution in Africa (AGRA).

References

- Adesina, Akin. 2004. “Making markets work for the poor in Africa.” A presentation at the Presidential-Level Seminar on Innovative Approaches to meeting the Millennium Hunger Development Goal (MDG) for Africa. July 5, 2004. United Nations Conference Centre. Addis Ababa, Ethiopia.*
- Asaba, J.F., R. Musewe, M. Kimani, R. Day, M. Nkonu, A.W. Mukhebi, A. Wesonga, R. Mbula, P. Balaba and A. Nakagwa. 2005. “Bridging the information and knowledge gap between urban and rural communities through knowledge centers: case studies from East Africa.” Unpublished manuscript. CABI. Nairobi, Kenya.*
- Asaba, J.F. 2006. Expert Consultation on “Identification of Pathways to Improved Dissemination of Research Information in Sub-Saharan Africa.” November 24, 2006. CABI. Nairobi, Kenya.*
- EAC Secretariat. 2008. “The Draft EAC Time-Bound Programme for Elimination of Identified Non-Tariff Barriers.” Arusha..*
- Meuleman, L. 2007. “Impact study of the market information system of KACE in Kenya.” M.Sc. Thesis. Faculty of Bioscience Engineering. Catholic University of Leuven. Leuven, Belgium.*
- Njukia, J., J.F. Asaba, A. Okolla and A. Wesonga. 2004. “Strategies for pro-poor agricultural knowledge systems in East Africa.” Draft report. CABI. Nairobi, Kenya.*
- Tollens, E. F. 2006. “Market Information Systems in sub-Sahara Africa: Challenges and Opportunities.” Poster presented at the International Association of Agricultural Economists Conference. August 12-18, 2006. Gold Coast, Australia.*

World Bank, 2008. "Non-Tariff Measures on Goods Trade in the East African Community." Report No. 45708-AFR.

Links:

<http://www.cck.go.ke/html/child.asp?childcontid> = Communications Commission of Kenya information on mobile phone growth in Kenya.

<http://www.kenyaimagine.com/Business-Technology/The-Digital-Village-project.html> = Ministry of Information and Communications Digital Village Project information.

www.abujacomex.com = Abuja Securities and Commodity Exchange website.

www.eagc.org = Eastern Africa Grain Council website.

www.ecx.com.et = Ethiopia Commodity Exchange website.

www.ideaamis.com = Malawi Agricultural Commodity Exchange website.

www.kacekenya.com = Kenya Agricultural Commodity Exchange Limited website.

www.mistowa.org = Network of Market Information Systems for West African States website.

www.uce.co.ug = Uganda Commodity Exchange website.



Market information systems' role in agriculture marketing: The case of Malawi Agriculture Commodity Exchange

Elizabeth Manda¹,

Abstract

Market information systems emerged in the context of market liberalisation of the 1980s. This paper presents Malawi Agriculture Commodity Exchange (MACE) market information system (MIS) experiences and the views of MACE MIS participants on the value of existing price and market information data that is available to them and improvements that they would wish to see.

The experience of MACE MIS to date, show that pure price information services can play a valuable role in facilitating the efficient working of agricultural commodity markets in Malawi. The provision of pure price information must, however, be seen as a public good freely available to all users. Experience also shows that delivery methods for this service need to be low-cost to access from the users' point of view, and in this regard, radio and SMS messaging have proved a powerful way of delivering price information. From an equity point of view, a regular radio slot is very attractive as it is like talking to millions of listeners. SMS is of increasing importance, and suggests that future priorities in the development of MACE MIS should focus in part on the access of poorer farmers and traders to mobile telephony.

There are also a number of encouraging developments over the past 3-4 years – the success of MACE franchisees and farmer groups' services, the use of SMS to conduct trade transactions via MACE and partnerships for efficient service delivery.

Introduction

Malawi Agriculture Commodity Exchange (MACE) began implementing an agricultural marketing information system (MIS) in 2004 as a project of the Initiative for Development and Equity in African Agriculture (IDEAA), funded by the Rockefeller Foundation through the University of Malawi and co-financed by the Government of Malawi through the Ministry of Agriculture and Food Security. The project objective is to improve access of smallholder farmers to price and market information. This paper presents the achievements and lessons of MACE MIS, including the views of market participants on the value of existing price

and market information data that are available to them and improvements that they would wish to see.

Background of market information systems

The literature shows that formal market information systems (MIS) in Sub-Saharan Africa (SSA) came in the context of market liberalization policies aimed at overcoming knowledge deficits and imperfect information created as a result of state withdrawal from markets when most SSA countries embarked on structural adjustment policies. In market-oriented economies, the key variable in the food market system has traditionally been price of the commodity, though non-price factors are also gaining importance. Due to the important role of prices in resource allocations and as a key variable in the agricultural market liberalization reforms, price has also been a key variable in market information systems (Goetz et al., 1986). From the experience of market information services in Mali, Mozambique, Zambia, Kenya and Malawi (Weber et al., 2005; Tollens, 2005) six factors have been considered necessary for a successful MIS. These are: (i) political commitment to serving both public and private sector market participants so that information is made freely available to all; (ii) sustainable funding through cost recovery mechanisms, such as membership and commissions by users (national and international donor financial assistance is needed, but should be supported by cost-recovery mechanisms); (iii) constant targeting, reassessment of user needs, feedback from users and analysis to ensure that the information generated and disseminated meets the needs of the users; (iv) strong local capacity to acquire and use market information (if the market information generated is not used locally, the effort constitutes a waste of resources); (v) strong human resources for managing and running a results-oriented MIS to ensure that the information generated has value; and (vi) an effective institution that can maintain and provide timely services.

Various types of MIS

Several types of systems have been piloted in SSA, including the Technical Center for Agricultural and Rural Cooperation EU-ACP (CTA), the Market Information Systems and Traders Organizations in West Africa (MISTOWA), the Regional Agricultural Trade Expansion Support Program (RATES), the Regional Agricultural Trade Intelligence Network (RATIN), and the Agricultural Market Information System of Uganda (Foodnet). Advancements in digital communication systems such as radio, mobile phones,

¹Director, IDEAA-Malawi, P/Bag B345, Lilongwe, Malawi. Corresponding author (emandas2000@yahoo.com)

the Internet and satellites, have contributed tremendously to the timely dissemination of information (Tollens, 2005). MIS help in facilitating the interaction of private-sector buyers and sellers in agricultural marketing (Weber et al., 2005). However, questions emerge as to how far MIS services should go in terms of involvement in linking farmers to markets (Poulton, 2006). The Kenya Agriculture Commodity Exchange (KACE) and the Malawi Agriculture Commodity Exchange (MACE) combine price information with trade facilitation services (Tollens, 2005). These services involve linking farmers or sellers with buyers of agricultural commodities. Putting into place sustainable market information systems to provide timely information that is easily accessible to everyone is not an easy task because of a lack of mechanisms for users to pay for the service (Weber et al., 2005). One feature of MIS in SSA is that no real impact evaluation had been done, thus it has been impossible to determine whether MIS services have contributed to improved efficiency of agricultural markets (Tollens, 2005). This paper examines the achievements, impacts and lessons of MACE MIS in providing price information and trade facilitation services to smallholder farmers in Malawi.

Malawi Ministry of Agriculture and Food Security MIS services

Organizations providing marketing information services in Malawi include the Ministry of Agriculture and Food Security (MOAFS) and MACE. The MOAFS collects retail prices, farm gate prices, and livestock and horticulture prices from over 80 markets scattered across the country on a weekly basis. The information is disseminated on a weekly basis through emails to various institutions and sometimes once a month through the weekly newspapers and the mobile phone short messaging service provided in partnership with the MACE MIS. The information generated lacks trade facilitation information.

MACE MIS

MACE was launched in January 2005. Its mandate is to provide price and market information services to buyers and sellers of commodities by establishing and operating a commodity exchange of the highest integrity, available to Malawian, as well as regional and international, buyers and sellers based upon an open and free market system for the mutual benefit of participating sellers and buyers.

The overall objective of the MACE MIS is to make markets work better for smallholder farmers and lower the risks and

transaction costs that hinder market development in Malawi. Specific objectives include: facilitating linkages between sellers and buyers of agricultural commodities; empowering farmers, traders, processors and other market participants with relevant and timely market price information and intelligence that enhances their bargaining power and competitiveness in the market place; providing a transparent and competitive price discovery mechanism through the operations of the exchange trading floor; and harnessing and applying the power of information and communication technology (ICT) as a strategic tool for rural value addition and empowerment.

The MACE MIS has several components. The MIS is built on two pillars: a price information service (daily prices) and trade facilitation services (matching bids with offers). The market price service covers cereals, pulses, vegetables, tubers, fruits, spices, livestock and fertilizer. It started with three markets in 2005 and expanded to 13 markets by 2006. In addition, retail market prices from 38 markets collected by MOAFS enumerators are transmitted by SMS through MACE. Trade facilitation services involve receiving offers to sell and bids to buy from farmers and clients. Through receipt of bids and offers the following trade information is collected for various commodities: types, quantities, quality and prices of commodities offered for sale (supply) and bids to purchase (demand), where (different places/markets), when, and by whom (seller/buyer contact addresses/phones). The information is collected, updated, and disseminated daily. The system generates internal reports of daily prices and bids to buy (demand) and offers to sell (supply), which feed into trade transactions linking buyers and sellers.

The system has the following implementation structures: a central hub based in Lilongwe, Malawi, which is responsible for receiving and processing the information and sending it out daily using various channels; three Market Information Centers (MICs) in Lilongwe, Mzuzu and Limbe, and ten franchised market resource centers in Karonga, Jenda, Rumphu, Kasungu, Mitundu, Lobi, Lizulu, Liwonde, Mwanza, and Muloza, which are also responsible for collecting information in the field and sending it to the hub. Franchising is a business relationship between MACE, as the franchisor and owner of business rights, and the franchisees (operators of businesses) who work in a framework coordinated by the MACE hub. The operator owns the business generated from trade facilitation and is also responsible for price information collection, while the MACE hub is responsible

for coaching and developing partnerships in support of the franchisees in return for “a consideration”. The other tools used by MACE are farmer-managed market information centers, black chalk boards for displaying offers to sell and bids to buy, a mobile phone SMS with Telekom Networks Malawi, a website (www.ideaamis.com) and email, and a weekly radio program in order to reach out to various categories of MIS users. MACE also works with the MOAFS Joint Technical Secretariat for dissemination of information to NGOs.

Methodology

MACE target beneficiaries and implementation principles

MACE is a development initiative that seeks to bring about development change, but with a business approach for long-term financial sustainability. In this respect, MACE seeks to mobilize smallholder farmers organized in groups, associations, or cooperatives to improve their capacity for competitiveness in the market place through provision of reliable and timely market information and related services. In addition, MACE is built on the principles of cost recovery for financial sustainability beyond the initial period of donor funding, i.e., users of services should pay for them, albeit after an introductory period. This has been achieved, with the introduction of commissions on successful trade transactions linked through MACE services. The revenue generated is ploughed back into improving and providing services on a financially sustainable basis. However, in view of the fact that the target beneficiaries are smallholder farmers, the majority of whom cannot pay for the full cost of the service, MACE is implemented as a public/private initiative. For this reason MACE has strived to develop various partnerships and attract public funding. MACE also strives to ensure that farmers have access to MIS services for all their agricultural produce (they often grow more than one crop). For economies of scale and geographical spread, MACE is implemented as a commodity neutral market information system. This means that MACE aims to make information available on all agricultural commodities that are important to farmers.

The target beneficiaries of MACE are smallholder farmers who benefit through increased market access from trade facilitation and access to price information. Other indirect beneficiaries are small-scale entrepreneurs; private-sector buyers, including processors, through access to produce; and government, through taxes from the increased incomes of smallholder farmers who are able to better access markets.

Data gathering for the paper

To generate the information presented in this paper, two kinds of data gathering methods were used: desk research using data already available within MACE, and surveying MACE MIS users. The survey was carried out from April to June 2008, with the aim of discovering a range of information concerning the users of MACE MIS services. What was working and not working and why? How did users rate the usefulness of the service, and what were the key food marketing problems they faced and the means to overcome them. Forty-one respondents were selected randomly from MACE users, by the type of MACE tool used to access MACE MIS. The selection breakdown was as follows: 13 SMS users were selected from among 1,398 SMS cell phone numbers; 2 random email addresses were selected from 370; 15 office visitors were selected from among 82 visitors; 4 workshop participants were selected from 82 participants in MACE annual stakeholder meetings; and 7 individuals were selected from among 54 radio listeners. The radio listeners sample population was based on listeners registered from February 2008 to March 2008, because this is the period during which MACE had started documenting listeners who call and give their phone number contacts (previous radio programs did not have the means for recording listeners as the program used to air pre-recorded information). The sample population for other tools was based on users who had been involved from January 2007 to January 2008.

A structured questionnaire was used to collect the data. Participation in the survey was voluntary and each respondent signed a consent form. The respondents were interviewed through a combination of face-to-face surveys, and by returning the questionnaires to MACE using a pre-stamped envelope. Many survey forms were not returned. Possible reasons for this include not receiving the letter, change of address, posting system inefficiency, or just not wanting to respond.

Achievements and results

The following section presents an analysis of data of MACE MIS already available which is later used with the findings from MACE MIS users survey to interpret the achievements and lessons of MIS in agriculture marketing.

Examination of MACE MIS data

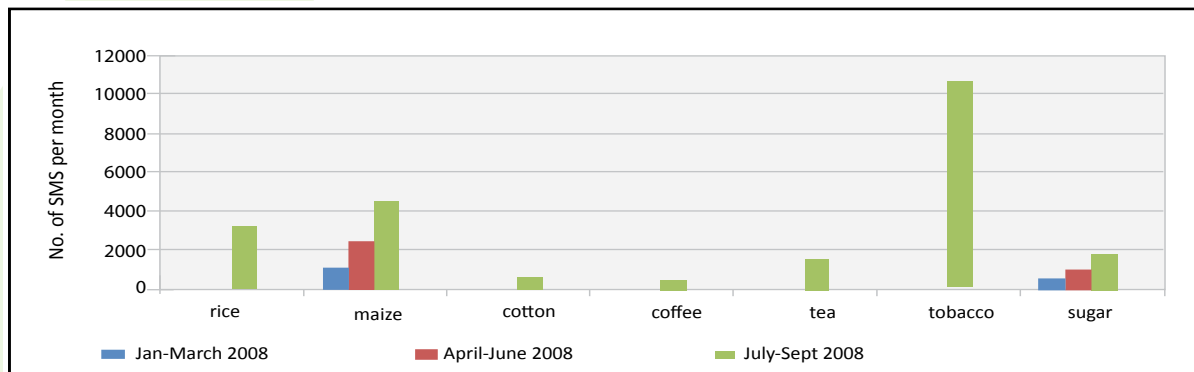
Short Messaging Service – MACE uses two private mobile phone companies, TNM and Zain Malawi, for dissemination

of agricultural prices, though under different arrangements whereby TNM is contracted directly and Zain is contracted through a third party. The advantage of the TNM system is that it can be used not only to access prices in real time, but also to sell or buy agricultural commodities. The Zain system is only for accessing price information. With the Zain service, which started in February 2008, total SMS usage for accessing price information from February 2008 to September 2008 was 27,675 messages. This gives an average of 3,075 SMSs per month, which is comparable with TNM whose average is 2,000 to 3,000 SMSs per month since 2005. However, the dissemination of agricultural prices through Zain has been accelerating every quarter, with the largest growth from July to September 2008 (22,721 messages were sent in 3 months, giving a monthly average of 7,573 per month). The reason for this is that in the Zain system the price service is available on the menu of the SIM card, which makes it easy for customers to access the information. By contrast, a TNM customer has to enter a sequence of instructions manually in order to access prices. Tobacco prices were the most frequently accessed, followed by maize (Figure 1). These are the two most important crops in Malawi.

Tobacco is the main cash earner and export crop for Malawi, while maize is the main staple food crop, hence more users are interested in their prices. SMS is potentially an extraordinarily

According to statistics on the TNM website, the two mobile phone companies have a combined total customer base of 1,425,814 subscribers, comprising 461,814 TNM subscribers (August 2008) and 964,000 Zain Malawi subscribers (June 2008). This means that for MIS services the SMS customer base that MACE MIS should strive to reach is over one million subscribers.

Websites and email – MACE uses the www.ideaamis.com website as one among several methods for dissemination of agricultural marketing information. At present the outreach of this service is extremely limited, due to the absence of the required infrastructure and access to the Internet in most rural areas. Moreover, only 2% of rural Malawians have access to electricity (GoM-HIS, 2005). For these reasons, usage of the Internet service has ranged between 50 and 300 hits per month. Related to the website is email, a tool that is mostly used for dissemination of daily price and market information. Occasionally the services provided by MACE email have been used to receive offers for sale or bids to buy. The MACE website and email services hold considerable commodity exchange potential in Malawi. However, there is an important risk that a digital divide will open up between the few who can access and make full use of these services, and the many that are not able to do so due to infrastructural, hardware and cost constraints.



Source: Author, derived from MACE data

Figure 1: SMS agricultural prices usage statistics 2008 through ZAIN Malawi

cost-effective means of trading in crops when it is considered that one SMS costs 0.10 USD, as compared to the amount of money and time that would be spent by a farmer or trader travelling to a physical market. Currently TNM and Zain are the only operators involved, but the other two mobile phone companies operating in Malawi have recently been granted licenses to operate.

Future development of these services clearly needs to devise and prioritize ways of avoiding this outcome.

Through email, an electronic mailing list of 360 addresses receives daily prices. These include mostly NGOs, donors, and farmer associations, and relatively few individuals.

Radio – The use of the radio for dissemination of agricultural marketing information started in January 2004. The program was run weekly with pre-recorded information, first for 15 minutes, and then later for 30 minutes, at 6:00 pm. The 6:00 pm time was selected because it was a prime time. Most radio listeners, especially farmers, would be available to tune into the program after spending their day on the farm or on other activities. The program was run in partnership with various international institutions, such as the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), who contributed from 2004 to 2006, Sasakawa Global 2000, and the International Centre for Soil Fertility and Agriculture Development (IFDC), which joined in 2006 for a few months. The content and format of the program had to some extent reflect the interests of these partners, and for this reason had included maize, groundnut and fertilizer

extension messages, in addition to price and trade opportunity information. These were the interests of SG2000, ICRISAT, IFDC and MACE, respectively.

The program became interactive in January 2008 when it changed from broadcasting pre-recorded market information to a live phone-in program, which allows listeners to place offers for sale or bids to buy commodities, thus permitting two-way real time exchange. The live radio phone-in program has resulted in the generation of bids and offers, and finalization of exchange transactions on air. The program is now run in collaboration with MOAFS and the Agriculture Rural Development Program (ARDEP) Market Access Project. Partnerships in the running of the radio program have been an important element because buying airtime to run the program is not cheap. It costs Mk 32,000 (~US\$ 230) per program. However, the use of radio is a promising

Table 1. Spatial distribution of sellers seeking trade linkage services at the MACE hub in 2008, in the form of offers to sell

District	%	Frequency distribution of sellers by source of request	
Blantyre	7.5	75	Blantyre (21), Chileka (3), Kachere (1), Limbe (42), Lunzu (7), Machinjri (2), Michiru (2), Zalewa (1)
Dedza	5.7	57	Lobi (32), Dedza (17), Bembeke (1), Chimbiya (1), Mtendere (3), Thete (3)
Kasungu	8.1	81	Chamama (2), Chatoloma (1), Kasungu (66), Nkhamenya (7), Santhe (4), Chulu (1)
Lilongwe	12.5	125	Various areas (14), Chiseka (1), Chitedze (3), Chitipi (2), Kalumbu (1), Likuni (1), Lilongwe (93), Lumbadzi (1), Malingunde (2), Mitundu (6), Mpingi (1), Nathenje (4), Njewa (2)
Mangochi	1.5	15	Monkey bay (9), Mangochi (1), Namwera (2), Ulongwe (3)
Mchinji	1.6	16	Namitete (3), Njala (1), Mchnji (12)
Mzimba	8.4	84	Kanjuchi (41), Mzimba (7), Ekwendeni (1), Emfeni (17), Jenda (15), Luwerezi (1), Mafundeya (2),
Mzuzu	2.4	24	Mzuzu (24)
Ntcheu	12.0	120	Ntcheu (3), Balaka market (40), Manjawira (1), Lizulu (23), Ntonda (52), Kampepuza (1)
Others	13.0	130	Balaka (Balaka, Mdeka), Chikwawa (Chikwawa, Nchalo, Ngabu), Chiradzulu, Dowa (Dowa, Mponela), Karonga (Kaporo, Kyungu), Liwonde; Machinga (Machinga, Ntaja), Mozambique Mitundu, Mulanje (Mulanje, Muloza, Luchenza, Juma), Mwanza, Nkhatabay (Chintheche, Nkhatabay), Nkhotakota (Dwangwa), Nsanje; Ntchisi (Ntchisi, Mawira), Phalombe; Salima (Salima, Chipoka), Thyolo (Bvumbwe, Thyolo), Zomba (Chingale, Zomba, Thondwe)
Phone	27.4	274	Only contact phone numbers were provided so difficult to tell their geographical spread
Total	100	1001	

Source: MACE data

tool for dissemination of information as it has the potential of reaching the whole population of Malawi (over 13 million people) with key messages.

Users of MIS

Spatial distribution of MIS users and type of users – Users of MACE MIS services for trade facilitation services, according to 2008 data, are spatially dispersed across the country, with some users even from neighboring country’s border areas with Malawi, like Mozambique (Tables 1 and 2). The demand for services through offers was received from 27 of the 28 districts of Malawi with the exception of Likoma (Table 1).

MACE has physical offices in only 12 districts. This means that the majority of the districts were reached through the radio program, and in association with other activities such as market shows, training of farmers in MIS use, participation of MACE in trade fairs and partnership with other NGOs and projects. These included the World Agroforestry Center (ICRAF), the National Smallholder Farmers Association of Malawi (NASFAM), and Concern Universal Microfinance Organization. The increased demand for trade linkage services in Ntcheu and Mzimba is mainly due to farmer empowerment activities. These were done through the Agricultural Research and Development Program (ARDEP) Food Security through Market Access Project for two

groups in Ntcheu and two groups in Mzimba, which made the groups appreciate the importance of market information services to their communities.

Demand for services in the form of bids to buy also came from a diversity of locations not only in towns or areas where MACE has offices but also in rural areas where MACE does not have offices. However, most rural places where MACE does not have offices registered low demand for services. The majority of buyers looking for information on produce supply are concentrated in Blantyre city, followed by Lilongwe city. Blantyre city (population 661,444) is the commercial center of Malawi with a lot of food and animal feed processing industries, while Lilongwe (population 669,021) is the capital city with a large proportion of people having high purchasing power. Thus far, these two cities form the large markets for agricultural produce and trading activities concentration in Malawi. Again, the buyers who have sought market linkage services are spread across 18 of the 28 districts of Malawi, with those not registering high demand being clustered as ‘other areas’ (Table 2). Some of the buyers of produce are also farmers, most of whom are based in remote rural areas. MACE has no restrictions on who should access its information and trade.

Table 2. Spatial distribution of buyers voluntarily looking for trade linkage services at MACE hub in 2008 in the form of bids to buy

District	%	Frequency of buyers by source of request
Blantyre	24	45 Blantyre (17), Chileka (1), Limbe (25), Lirangwe (1), Nkula Trading (1)
Kasungu	7	14 Kasungu (12), Nkhamenya (1), Santhe (1)
Lilongwe	23	43 Chinsapo (1), Area 49 & Area 3 (4), Chitipi (2), Lilongwe (34), Mitundu (2)
Mzimba	9	16 Ekwendeni (1), Mabilabo (1), Kanjuchi (11), Mtwalo (1), Mzimba (1), Chamama (1)
Mzuzu	7	14 Mzuzu (14)
Ntcheu	5	10 Balaka (5), Lizulu (4), Ntonda (1)
Phone	9	17 Phone (17)
Other areas (1-3% contribution)	16	30 Dedza (Lobi), Dowa (Dowa, Mponela); Karonga; Mchinji; Mulanje (Luchenza, Muloza); Mwanza; Nchalo; Nkhotakota (Dwangwa); Rumpi (Nchenachena, Betere, Rumpi); Salima; Thyolo; Zomba (Domasi)
Total	100	189

Source: MACE Hub Data

It should, however, be noted that of the 12 MACE offices in 12 districts, six were franchised in April 2008. The franchisees have the capacity to meet most of the trade demand within their areas on their own, hence do not report most of those demands to the MACE hub. Instead, they report only those that need MACE network support. This therefore contributes to apparently low trade facilitation demand from Karonga, Jenda, Mitundu, Liwonde, Mwanza and Muloza. The results presented in Tables 1 and 2 are therefore mainly MACE figures, with a few coming from the franchised offices. Most of the franchised offices have registered very high demand for MIS services in trade and market linkage services, estimated at 10,000 users from March-December 2008. The increased demand for services in franchised operations came because of diversified marketing services that franchisees are able to offer with the backing of a credit facility, which was made available to them through the facilitation of MACE. With resources from the Rockefeller Foundation, MACE guaranteed franchisees access to loans from a commercial bank, which would not have offered the loan without the credit guarantee facility. The credit facility provided an important boost towards bulking of produce, as farmers require upfront payment for their sales and most public institutions in markets take up to 6 months to pay for purchases.

The franchisees are essentially running the services as independent brokers. MACE decided to start piloting the franchising innovation with six of its rural offices as a way of ensuring full utilization of capacity of the offices in service delivery in an efficient and cost effective manner. The selection process of franchising involved advertising and interviews, but the key variable was the interest of the franchisees to serve smallholder farmers. To date, the franchisees have been made up of 50% former MACE staff and 50% non-MACE staff. The major conclusion is that demand for MIS trade and market linkage services by sellers is there. The next section of this paper addresses the question: what is the size of the buyers and sellers that seek such, and how much of the demand has been satisfied? This will be examined by looking at the size of sellers and buyers who have sought trade facilitation services, and the trade volumes concluded from 2005 to 2008.

Annually, there are many sellers seeking trade facilitation, as shown in Tables 1 and 2. The majority of sellers who seek trade linkage services are small-scale sellers or traders wanting to sell from less than a bag up to 5000 bags (250 tons of a crop) (Table

3). In general, few large buyers must be matched with the small volumes of goods offered for sale from many sellers. Some offers for sale and bids to buy have not been satisfied due to failure to reach agreement on the price between the buyer and seller, or because of the need for immediate payment upon delivery by farmers or sellers when public institution buyers take time to pay, or because of the often small and fragmented volumes for sale.

Trade volumes of between US\$ 215,000 and US\$ 1,500,000 took place annually between 2005 and 2008. Trade volumes picked up rapidly in 2007, with a 60% growth over the previous year, while 2008 registered a trade volume growth of over 500% above 2007. The main reasons for this large growth in 2008 was the introduction of innovations that included: the live radio phone-in program called "Supermarket in the Air" for the trading of agricultural produce; the franchising of six field offices into Market Resource Centers; and the establishment of farmer-managed market information services.

Of the Mk 212 million trade volume registered in 2008, these innovations contributed as follows: MACE franchisees, Mk 90.5 million; farmer-managed market information services, Mk 10.0 million; the radio program, Mk 36.2 million, and the remaining Mk 75.2 million by MACE directly. It is anticipated that, as the business of the franchisees grows, MACE trade volume will decline, and MACE will assume a greater role as central coordinator. One example in which the coordinated development of partnerships was done by MACE occurred during the 2008/09 crop season. Government subsidized maize seed production and MACE entered into partnership with seed companies, such as Seed Co and Monsanto. These partnerships involved 6 franchisees, 3 farmer-managed MIS centers, and MACE subscribers, all of whom participated in selling seed without each one having to individually negotiate the deals.

Four market information system centers managed by farmers have been set up – two in Ntonda and Balaka, in Ntcheu district; and two in Emfeni and Kanjuchi, in Mzimba district – following a similar model developed by MACE which allows a committee of ten members in each center to receive offers for sale and bids to buy from farmers within their communities and be able to facilitate trades. To ensure that the wider society becomes aware of the goods on offer and demanded at their centers, the communities send their offers and bids to the MACE hub for airing on the live phone-in radio program. Through this process, farmer committees have been able to conclude sales, thereby

contributing to their market access both locally and nationally. They generate their revenues through savings mobilization and commissions, but most of them have offered the services for free because they are only one year old and wanted to interest the communities first.

The live radio program started in January 2008. It runs weekly every Friday for one hour from 5:00 pm on the Malawi Broadcasting Corporation (MBC) national radio station. Sellers and buyers phone in to trade while MACE staff attend to the calls as they come in, and one staff member presents the program using current data on offers to sell and bids to buy received during the week. A total trade volume of Mk 36.2 million was realized in 2008, with Mk 21.8 million in trades taking place between buyers and sellers who contacted each other independently after listening to the radio. About Mk 15.0 million in trades took place with the facilitation of MACE, which matched buyers and sellers to complete the trades.

Major markets for concluding trade transactions have varied. From 2004 to 2006, the major ones were spot markets, but this

changed greatly in 2008 with the capacity-building efforts of the franchisees that started serving most of the spot markets from the private sector. MACE began concentrating on tender markets from public institutions, which are difficult markets for small-scale farmers and entrepreneurs to access on their own, as they have complicated tendering procedures with strict delivery deadline requirements. More generally, an increasing proportion of urban and institutional markets require high quality products, timely and regular deliveries, and economies of scale that the majority of small farmers may find difficult to meet (WDR, 2007). MACE has had physical trading floors operating in Lilongwe and Blantyre once a week for 3 hours, but the floors have not been very effective in attracting active sellers and buyers on specific days and time. What has been happening has mostly been spot trading, in which MACE receives offers to sell and bids to buy at different times, using various means described earlier. MACE's job has been to match these orders as they come. There is, however, a need to revive the trading floor system, because this promotes transparency and fair price discovery.

Table 3: Size of sellers and buyers seeking trade linkage services

Quantities	2005		2006		2007		2008	
	Sellers	Buyers	Sellers	Buyers	Sellers	Buyers	Sellers	Buyers
1-10 bags	85	27	78	26	80	28	281	56
11 -50 bags	60	7	121	13	84	4	131	24
51- 100 bags	78	7	59	8	50	0	45	15
101-500 bags	77	10	84	23	84	9	67	10
501 - 1000 bags	22	15	38	6	22	3	11	4
1001-5000 bags	26	11	24	17	14	6	16	13
5001-10000 bags	4	2	3	2	3	4	0	6
10001-20000 bags	1	2	1	1	0	1	0	2
20001-49999 bags	1	0	0	1	4	0	1	0
50000 bags	0	3	1	2	4	0	0	0
Over 50,000 bags	57	40	66	28	90	23	218	81
Did not indicate	10	7	11	12	3	1	26	0
Total or <i>n</i>	421	131	486	139	438	79	796	211
Total sellers & buyers	552		625		517		1007	
Concluded trade volume (US\$)	215,124		197,582		362865		1493024.47	
Trade vol. annual growth %			-4		60		502	

Source: MACE data

Price discovery mechanisms and commodities traded

One of the objectives of MACE has been to facilitate price discovery by both the seller and the buyer. Usually the seller offers to sell his/her commodity at a different price from the price that the buyer offers, with, in most cases, the seller offering to sell at a higher price than what the buyer is prepared to pay. The price at which trade takes place is therefore negotiated until a price that is agreeable to both the buyer and seller is reached. Two crops, beans and maize, are used here to demonstrate what happens between offer price to sell and bid price to buy, drawn from actual 2008 offers and bids. Buyers tend to under-price while sellers tend to over-price, with a few cases in which prices fairly overlap, as shown in Table 4. Through negotiation between the buyer and the seller, an agreed price at which the transaction takes place is derived. The negotiated prices are used for sales of commodities, which sellers and buyers freely choose to trade.

of samples from the buyer or seller and also physical verification of the whole consignment. Thus price, while clearly being at the center of exchange negotiations, is ultimately arrived at in the context of many other factors that are taken into account by buyers and sellers. The type of price used for trading at MACE in most cases is the wholesale price, but this varies depending on the volume of trade, with most buyers willing to pay slightly more for large volumes.

Commodity prices are set through negotiation at the time of sale based on the current market demand and supply, which in some cases has created a challenge for contract tender markets, especially with government institutions. The challenge comes when the commodity starts going off-season and becomes expensive, but tender prices are fixed. However, negotiations with buyers have resulted in upward price adjustments. The main commodities traded cut across cereals, fresh foods, and legumes.

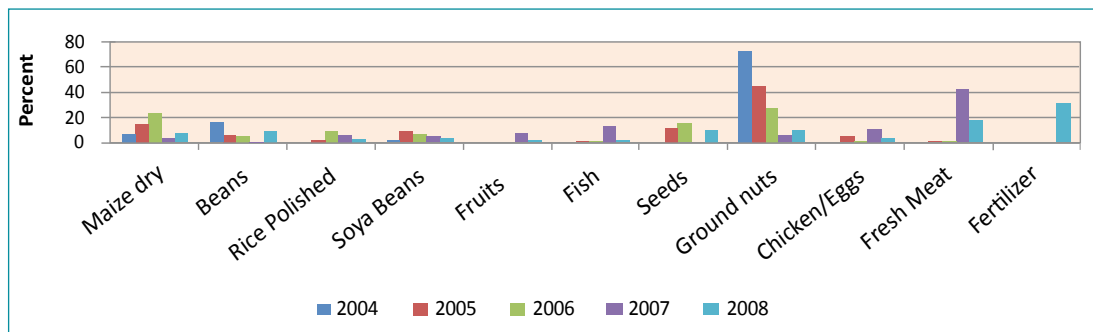
Table 4: Price Discovery

Months	Beans		Maize	
	Offer Price Mk/kg	Bid Price Mk/kg	Offer Price Mk/kg	Bid Price Mk/kg
January	120	*	*	*
February	80-90	*	28	20, negotiable
March	120, negotiable	90, negotiable	negotiable	negotiable
April	85-120	180, negotiable	24-40	45, negotiable
May	100-140	100	40, negotiable	20-40, negotiable
June	110-300	negotiable	negotiable	26-38, negotiable
July	140-180	140, negotiable	45-60	45-55, negotiable
August	50-200	*	55-79	50-55, negotiable
September	170-250	*	negotiable	
October	210-230	110		
November	170, negotiable	*		
December	194			

Source: MACE Data

The MACE hub acts as a facilitating mechanism for the exchange of information that results in an agreed price and other conditions for a transaction to take place. This additional information includes such factors as whether the buyer collects or the seller delivers, where the commodity is physically located, the quantity and quality of the commodity available for sale, and so on. Quality of produce is usually based on visual observation

Fresh foods, especially beef, grew strongly from 2007 (Figure 2) mainly because of the tender markets with public institutions, which most smallholder farmers cannot access on their own because of the complicated bidding procedure and requirements for regular deliveries. These are roles where MACE has particular strengths for improving the access of small farmers to market opportunities, in this instance due to MACE's familiarity with the state tendering process.



Source: MACE Data

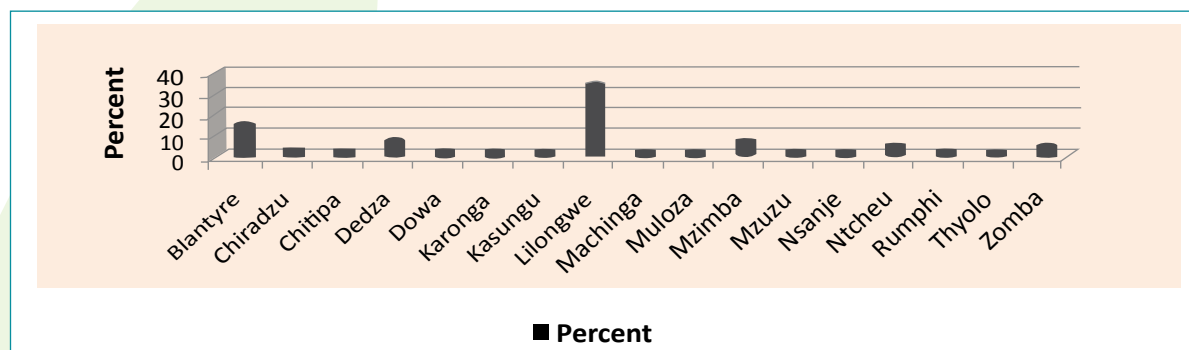
Figure 2. Main commodities traded 2004-2008 in percentage terms annually

Results of the MIS user survey

Having described the operation of MIS services already available at MACE, this section provides empirical evidence from the results of a MACE MIS users' survey, which was carried out with the aim of capturing the perceptions of MIS users on the usefulness the services offered, and identifying areas requiring improvement. Important parameters covered in this section include a description of users of MIS, the type of MIS services accessed, the usefulness of MIS services in decision-making, the uses of MIS, additional types of MIS services not currently provided but requested, and areas requiring improvement. Fieldwork with MIS users was conducted by the author in March-June 2008.

the site of the MACE office, and is where most large commodity traders in Malawi have their head offices. Moreover, Lilongwe has the highest density of mobile phone and Internet users in the country.

In terms of the profession or occupation of MIS users, the majority are small-scale businesspersons, followed by farmers, then government and private companies (Figure 4). NGOs, MACE staff, and MOAFS enumerators are also significant users, as facilitators to assist farmers and businesspersons to access MIS services.



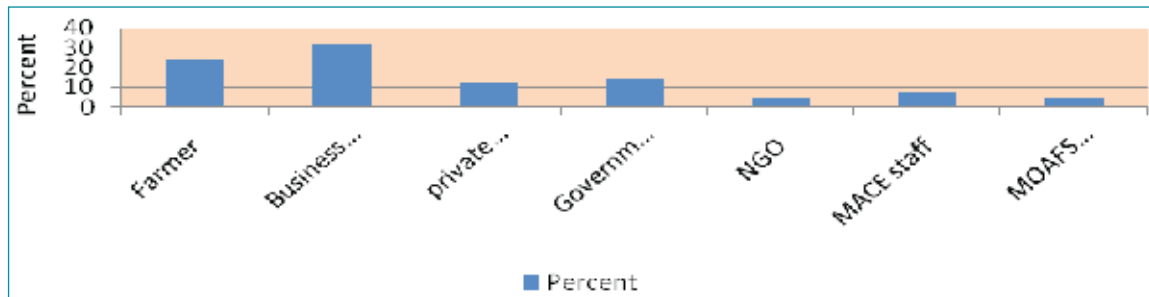
Source: Fieldwork of MIS users conducted by the author March-June 2008

Figure 3: Spread of MIS users by district in percentage terms

Description of MIS users

The MIS survey interviewed 41 users who access price information or trade facilitation services. The largest proportion of MIS users are located in the capital city, Lilongwe (34.1%), followed by Blantyre (14.6%), then Dedza (7.3%), Mzimba (7.3%), Ntcheu (4.9%) and Zomba (4.9%). The remaining districts taken together correspond to only 2.4% of users (Figure 3). The position of Lilongwe in MIS use is perhaps not surprising. This is

In terms of gender, 80.5% of MIS users to date have been men, while only 19.5% have been women. This reflects in part the lead that males in farming households take in marketing crops, even when it is women who conduct most of the physical operations of farm production. For MIS services to reach out to distant potential users there is need for support from facilitating organizations working with farmers and businesspersons to help create awareness of the availability of the services and



Source: Fieldwork of MIS users conducted by the author March-June 2008, N = 41

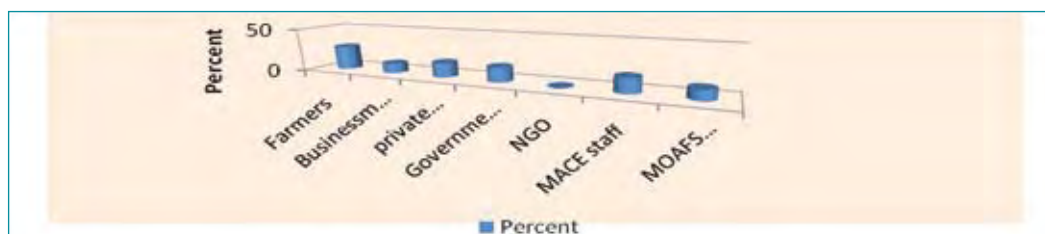
Figure 4: MIS users by category of organisation in percentage terms

the benefits that can result from taking advantage of their existence. In its four years of operation, MACE MIS has had partnerships with NGOs (Concern Universal Micro-Finance Organization (CUMO), Sasakawa Global 2000, and Land 'O Lakes Malawi), ICRISAT Malawi, and the Common Market for Eastern and Southern Africa (COMESA) with the aim of reaching out to small farmers and traders with MIS services. ICRISAT in Malawi promotes various crops but their interest in MIS centered on the groundnuts market. By contrast, Sasakawa Global 2000 was primarily interested in the value of MIS for the maize market. Both these organizations collaborated with MACE MIS on dissemination of production and market information over the radio in 2005 to 2006. Land 'O Lakes interest in MIS concerned the dissemination of price information through SMS in 2006 for dairy animals and milk products. The COMESA partnership was aimed at building the capacity of farmers and MACE staff in accessing and using MIS services, and building value chain analysis skills for MACE staff and franchisees. Thus MACE MIS services, apart from covering existing price and market information, had to add tailor-made services to suit various partners.

The major method by which users access MIS is through SMS (43.9%), while over 50% access the services through: office visits (34.1%), radio (19.5%), and email (2.4%). Access through the radio was expected to have scored higher, but the low number of people who listened to the live phone-in radio

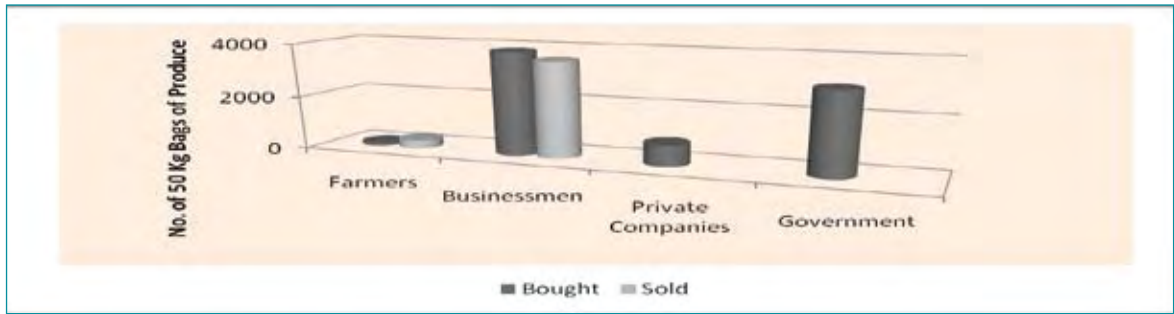
program in February to March 2008 was due to the program just commencing in mid-January 2008. Access to MIS through SMS increased, as a proportion of all means of access, compared to the MACE baseline survey of 2006, which recorded access rates of 36.3% through SMS, 61.1% through radio, 2.1% via the Internet, and 23.2% from black boards (Phiri, 2006).

It is important to note that the radio program started in 2004 broadcasting pre-recorded market information messages, but from mid-January 2008 the program changed to a live phone-in radio show. This is a more interactive program, which allows users to phone in and make trades on the radio. The blackboard as a means for information dissemination is still an important tool for users who visit MACE offices. SMS seems to be a preferred option because it is cost effective compared to office visits. With SMS, one can access information 24 hours/day as long as there is electricity. Obviously, this is not the case with office visits during working hours or over the radio on a weekly basis. Email for access to MIS services is the least used, and the reasons include lack of access to the required hardware and infrastructure, as well as cost. However, email is the most important means of disseminating daily prices to NGOs and donors in Lilongwe. The majority of SMS users are farmers (28%), followed by government officials, private sector companies, and MACE staff, all at around 17% each. Among this group, small-scale businesspersons use the services less than others (Figure 5).



Source: Fieldwork of MIS Users conducted by the author March-June 2008, N=41

Figure 5: SMS users by category of users in percentage terms



Source: Fieldwork of MIS users conducted by the author March-June 2008

Figure 6: Mean quantities of produce bought and sold in the 2008 season at the time of survey

The type of sellers who use MIS services to sell their produce are small-scale farmers and traders, and their mean quantity of produce sold per day is 3.6 and 38.3 bags, respectively, during the peak marketing season. Large private companies that seek MIS services were, at the time of the survey, not engaged in selling, as this was a period when previous purchases were being moved to storage (Figure 6). Small-scale traders dispose of (sell) the produce they purchase as soon as they buy it. Storage of produce, especially cereals, is very important for Malawi because the country relies on rainfall for its production and the rains come only once per year and for only a few months. Storage therefore ensures availability of commodities throughout the year to meet consumption needs. Evidence shows that margins for most agricultural produce increase with storage, hence storage is an area of keen interest for MACE to ensure the supply of commodities to be traded on the exchange and also for farmers and small-scale entrepreneurs who benefit from better prices during off-season periods. MACE currently does not store produce. This may change in the future if it can develop warehouse services to be used by sellers and franchisees as they wait to trade their commodities on the exchange. Such a service would also boost MACE work, as it would provide guaranteed stock when a bid to buy is registered.

Type of market information services accessed and usefulness of the services

Close to 50% of MIS users accessed price information only, 35% accessed trade facilitation services and 15% received both price and trade facilitation services. Over 90% of MIS users indicated that the information they accessed was helpful to their decision-making. In terms of usefulness, we looked at how well MACE was

delivering its services and whether they met users' expectations. Users ranked highest the timeliness of the MIS services, followed by their accuracy. The least important factor was inconsistency, meaning that users were less concerned that the same type of information was provided on a regular basis (Table 5).

Table 5: Ranking of usefulness² and uses of MIS services

Ranking	Scores	Usefulness
1	110	timeliness
2	127	accuracy
3	142	relevance
4	147	precision
5	200	inconsistence

Source: Fieldwork of MIS users conducted by the author March-June 2008

In terms of what MACE users do with the information they receive, finding buyers was ranked as the most important use of MIS, followed by assessing demand for commodities and, interestingly, the least important use was to find out where better prices were on offer (Table 6).

Table 6: Ranking of uses³ of MIS services

Ranking	Scores	Uses
1	120	finding buyers
2	122	assessing demand
3	142	knowing consumer preferences/market requirements
4	150	improves price bargaining
5	204	knowing where better prices are offered

Source: Fieldwork of MIS users conducted by the author March-June 2008

²MIS users were asked to rank "usefulness" of MIS services on a scale of 1 to 5 with the most important being allocated a score of one and least important 5 (or 6 where the question was not answered). The variable with the lowest scores was therefore the most important.

³Uses of MIS were ranked on a scale of 1 to 5 with the most important being allocated a score of one and least important 5 (or 6 where the question was not answered). The variable with lowest scores was most important.

This may reflect the relative immobility of farmer sellers compared to the traders to whom they sell. Nevertheless, it is considered that farmers' use of MIS services can potentially play a major role in strengthening the hand of farmers in their price negotiations with traders. Finally, users were asked to rank the additional types of information that they thought would add value to MIS services in the future. The results of this question are summarized in Table 7 and are quite interesting. The highest score was obtained for a question on transport brokerage information. In other words, MIS users would find it particularly useful to have regular information on the costs of moving produce available from different suppliers of transport services. This makes sense, especially for small- and medium-sized traders, who probably lack an overall view of the competitive cost of transport.

Table 7: Additional types of market information

Ranking	Scores	Additional types of market information required
1	198	Transport brokerage
2	220	Crop production guidance
3	221	Seed sources
4	229	Variety specification
5	241	Imports and export regulations
6	247	Grade and standards specification
7	258	Post harvest handling advice
8	260	Storage

Source: Fieldwork of MIS users conducted by the author March-June 2008

Other services prioritized were guidance on crop production, sources of seeds, and information on alternative crop varieties. However, these services stray into areas more typically considered in the province of agricultural extension. Therefore, some careful thought would be required concerning boundaries of competence regarding how far MIS should go to provide this kind of information.

Limitations of MIS in contributing to efficient agricultural markets

As part of the MIS user survey, respondents were asked to prioritize from a long list of well-known marketing problems that are encountered in Malawi. This list was drawn up after consultation with marketing specialists, as well as from the frequency of their mention in numerous reports and documents on agricultural marketing in the country. It is notable that finding

buyers is accorded the top priority (Table 8), suggesting that MIS users lack a choice of buyers for the produce that they have for sale at a given point in time. Small traders are the ones who buy produce directly from farmers in rural areas. The majority of these traders buy produce on their own account, and once they have made their purchases, they start looking for markets to sell it (as demonstrated in Figure 6, which shows that small-scale traders do not engage in storage and that they sell the produce as soon as they have bought it).

Table 8: Marketing problems

Rank	Scores	Marketing problems
1	197	Finding buyers
2	205	Transportation of produce from the farm to the point of sale
3	213	Poor rural roads
4	227	Lack of credit
5	252	Finding out selling prices
6	290	Storage costs
7	313	Loss of crops in storage
8	330	Use of inaccurate weighing scales
9	337	Poor quality of crops purchased from farmers
10	356	Theft
11	370	Failure by farmers to honour contracts
12	496	Lack of farm inputs
13	499	Lack of extension services

Source: Fieldwork of MIS users conducted by the author March-June 2008

This means that both farmers and traders face similar problems in finding buyers for their produce. MACE target clientele are smallholder farmers. However, a key limitation they face is the volume of commodities smallholders can offer for sale (when selling individually). Only a very small proportion of them belong to associations, hence there is a significant challenge in assembling (bulking) produce to facilitate trading. Traders are currently doing this in ad hoc ways, which blurs the distinction between wholesalers and retailers in working with various clients to achieve the overall objective of improving market access of smallholders.

Many of the other problems relate to rural infrastructure (poor rural roads and lack of transport), while others relate to adverse trader behavior (for example, inaccurate scales), or adverse farmer behavior (poor quality crops for sale). Lack of credit is an important factor for traders, who must finance purchases before

they realize an income from sales. Some of these problems can be improved through the use of MIS services (especially those related to bringing buyers and sellers together, and better price knowledge), while others relate to broader problems in the transaction costs of markets that cannot easily be tackled by improvements in MIS alone.

Lessons and conclusions

The major findings regarding MIS services in Malawi point to the fact that MIS services have a role in providing pure price information services, non-price information and trade facilitation activities in order to improve market efficiency. The experience of MIS to date, and our user survey, show that pure price information services can play a valuable role in facilitating the efficient working of agricultural commodity markets in the country. However, price information provision must be seen as a public good freely available to all users, otherwise it would merely advantage those users prepared to pay for the service over those users unable to pay (if MACE MIS was to charge for provision of price information). Facilitating trade exchanges is, however, an area in which MACE MIS can reasonably charge users for the service provided. Both sellers (farmers) and buyers – who in some case are also farmers – require MIS services as demonstrated by voluntary demand coming from all over the country. Those who have accessed the MIS services have found the services useful in their marketing decision-making. With price information services, both farmers and buyers are able to know the best price without expending a lot of resources to contact many different buyers or sellers. A commodity neutral information system is of greater benefit to the majority of smallholder farmers, as the same farmers usually grow more than one crop. The majority of buyers accessing MIS services are small-scale businessmen who also buy produce directly from farmers. The policy implication of this fact for MIS is that, if MIS services are to benefit smallholder farmers, it is important for those services to both target smallholder farmers and small-scale traders or entrepreneurs. Non-price information poses issues concerning the boundaries of MIS relative to the competence of other bodies that provide farmers with information. Advice on agricultural practices or seeds certainly falls into other spheres of public services, such as agricultural extension, but transport is an activity related to MIS.

Experience also shows that delivery methods for this service need to be low cost from the user's point of view. In this

regard, radio and SMS messaging have proved a powerful way of delivering price information. From an equity point of view, a regular radio slot is very attractive, since in every community quite a few people will have radios, and information given out by radio is probably disseminated widely by word of mouth. SMS is of increasing importance, and suggests that future priorities in the development of MACE MIS should focus in part on the access of poorer farmers and traders to mobile telephones.

Farmers are empowered by MIS services that combine pure price information and trade facilitation services. Such services could extend the reach of farmers to buyers not only in Malawi, but also in regional and international markets as this capacity develops. There are also a number of encouraging developments over the past 3-4 years – the success of MACE franchisees and farmer groups' services, the use of SMS to conduct market transactions via MACE, and partnerships in service delivery. MACE franchisees have benefited from the innovation by entering into a business they would not have done on their own, and the same is true for farmer-managed MIS. The fact that they are working under the MACE framework improves their status. This has helped them to attract other programs. For example, the Liwonde MRC MACE franchisee has attracted the BUGs program that is funded by the EU, and it has also linked with Opportunity International Bank. The Karonga MRC MACE franchisee has benefited from a CNFA grant, while the Kanjuchi farmer MIS has been selected by MOAFS for the mini-silos program, among other benefits.

Franchising of MIS services and farmer empowerment are long-term, cost-effective means for MIS. They are able to deliver services well and efficiently. The franchising innovation has been a success mainly because of the diversified marketing services they offer, but also because of the credit facility which made it possible for them to pre-finance and bulk produce from farmers for sale, both locally and to distant markets independently or through the MACE network. MACE plans to continue franchising the remaining four MIPs, but without a credit guarantee fund it is very difficult to franchise as banks are not willing to lend to young energetic men and women without collateral. Franchising is, however, contributing to the creation of a young generation of entrepreneurs, which is important for the development of agricultural markets in Malawi.

Farmer-managed market information systems (FAMIS) is a promising innovation, but requires a lot of resources for capacity

building of farmers managing the system and awareness creation of farmers in the surrounding communities who are meant to be the users and beneficiaries. The system also results in reduced trade transaction costs, as the communities are able to bulk the produce locally for sale to distant markets. Partnerships are also important for leveraging cost and efficiency in service delivery. MACE has demonstrated this by its use of radio and SMS in collaboration with NGOs and mobile phone short messaging service providers.

The finding that only 19.5% of MACE users are women means that there is need for deliberate efforts by MIS providers to ensure that women access their services. Awareness activities on MIS services are therefore important in order for MIS to reach out to all potential beneficiaries, especially smallholder farmers. Another finding is that small-scale buyers do not engage in produce storage (Figure 6). If markets are to develop to the benefit of smallholder farmers and small-scale buyers, there is need for investment in storage services at the local level. Storage support facilities for bulking services for use by small-scale buyers or other produce bulking players at the local level are therefore important.

Sustainable funding for MIS is a challenge. Price information is a public good, while willingness by users to pay for services – especially those who trade through the radio – is limited. This therefore calls for a combination of donor and government funding to be supplemented by user charges as a long-term strategy for provision of services until such a point that the MIS can generate enough resources from trade facilitation and other revenue generation mechanisms.

The results presented in this paper reflect a national-level aggregation. It would be interesting to have more detailed research on the impact of activities of MACE, especially in the various sites where it has franchised offices and market information centers.

References

- CTA. 2004. "Key Lessons for MIS." In: *CTA Conference on Role of Information Tools in Food and Nutrition Security in ACP Countries*. Maputo, 8-12 November 2004.
- Ellis, F. 1992. "Agricultural policies in developing countries." Cambridge: Cambridge University Press.
- IFPRI (n.d). "An extensive review of research findings on agricultural market reforms in Sub-Saharan Africa." Website based on forthcoming book by Khrallah, M., Delgado, C., Gabre-Madhin, E., Minot, N. and Johnson, M., available at www.ifpri.org/pubs/pubs.htm#fpr.
- Mukhebi, A. 2007. "Malawi Agricultural Commodity Exchange: Franchising Market Information Points." A Consultancy Report to Initiative For Development And Equity In African Agriculture (IDEAA), Malawi. Kenya Agricultural Commodity Exchange, Limited (KACE).
- Phiri, M.A.R. 2006. "Malawi Agriculture Commodity Exchange Baseline Survey." Lilongwe: Bunda College of Agriculture.
- Weber, M.T., C. Donovan, J.M. Staatz and N.N. Dembélé. 2005. "Guidelines for building sustainable market information systems in Africa with strong public-private partnerships." Food Security III Cooperative Agreement between US Agency for International Development, Global Bureau, Economic Growth and Agricultural Development Center, Office of Agriculture and Food Security and Department of Agricultural Economics, Michigan State University. Available at <http://www.aec.msu.edu/agecon/fs2/psynindx.htm>. Number 78, accessed November 2005.

Role of ICT-based MIS in enhancing smallholder producers' incomes: The case of MISTOWA in West Africa

Kofi Debrah¹

Abstract

The introduction of yield-enhancing technologies to farmers without accompanying efforts to link production to reliable marketing outlets is not likely to succeed because of the negative effects on prices and incentives. The USAID-funded project, "Strengthening Regional Networks of Market Information Systems for Traders' Organizations in West Africa (MISTOWA)" sought to improve farmers' access to domestic, sub-regional and global markets through a private-public partnership to develop and deploy an ICT-based market information system. After 3 years of implementation, approximately 12,500 beneficiaries from 15 countries in West Africa participated in the project – 33% of them producers and 38% traders. The project beneficiaries reported approximately US\$ 51 million in trade deals, translating into US\$ 4,080 per beneficiary or US\$4.33 per dollar of donor funds invested. Even though the earlier than anticipated project termination made it impossible to assess the real impact of the ICT-based market information system on smallholder incomes, there is enough anecdotal evidence from the beneficiaries to suggest that access to real-time market information provides incentives for investments in agriculture by smallholder farmers.

Introduction

Smallholder farmers in Africa typically face two types of marketing problems. First, they sell marketable surpluses on an ad hoc basis because they have limited access to reliable marketing outlets to sell produce at remunerative prices. Second, their ability to respond to ready and assured market opportunities in a timely manner is limited by labor constraints, lack of access to credit, lack of market information, and poor post-harvest facilities.

As a result of these problems, farmers' incomes from agriculture are low and variable, making agriculture unattractive. As long as these problems exist, there will be little incentive for farmers to invest in yield-enhancing technologies to boost agriculture, the main engine of economic growth in developing countries. Low investments in agriculture translate into low productivity

and result in the inability of countries to produce enough food and raw materials to meet human and industrial demands. Under these circumstances, governments' dependence on imports increases, raw materials from domestic sources become inadequate, and agro-industries fail to perform to their potential, leading to loss of revenues and low employment generation. The low and variable incomes from agriculture increase the number of youth migrating from rural to urban areas, increase urban unemployment, and could potentially cause social unrest. The project "Strengthening Regional Networks of Market Information Systems for Traders' Organizations in West Africa" (MISTOWA) sought to address these issues, as well as to meet its own particular challenge of low intra-regional trade in agricultural produce in West Africa.

This paper seeks to contribute to the development of a framework for improving agricultural markets in support of the African Green Revolution by sharing the MISTOWA experience, lessons learned, and the potential to scale up the information and communication technology (ICT)-based market information platform for use by smallholder farmers in Africa.

Overview of the MISTOWA Project

Geographic coverage: West Africa, with focus on Benin, Burkina Faso, Côte d'Ivoire, Ghana, Guinea, Mali, Niger, Nigeria, Senegal, the Gambia and Togo.

Duration: October 1, 2004–September 30, 2007, with funding from the United States Agency for International Development (USAID) and Agriterra; then October 2007–March 2008 under Hewlett Foundation funding.

Commodity coverage: Rice, maize, cassava, tomatoes, onions, cashew, shea nut/butter, fertilizer, cattle, red meat, cowpea, fish, mangoes and sesame.

Funding and funding sources

- US\$10,400,216 from USAID/West Africa (Economic Growth and Agriculture);
- US\$1,400,000 from Agriterra (the Netherlands) to support capacity building of producers and their organizations and to improve their access to markets; and
- US\$300,000 from the Hewlett Foundation (October 2007–March 2008).

¹Previously Chief of Party (MISTOWA Project) and currently IFDC Representative in Ghana and Regional Manager, Ghana MCA Project in the Northern Intervention Zone. Corresponding author (kdebrah@ifdc.org or kofidebrah@usa.net).

The MISTOWA project started with a 6-month pre-project assessment of needs

As a bid requirement, potential bidders were to conduct a 6-month assessment to identify stakeholders, their needs, and their expectations in order to factor these into the project implementation design. IFDC invested \$200,000 that was matched by USAID/West Africa. The period was used for a wide consultation during which discussions were held in six countries with producer groups, trader groups, market information service providers and others. These in-country consultations culminated in the holding of a regional workshop of stakeholders to agree on issues related to:

- Market information needs for selected commodities and inputs;
- Means of communication and possible sources and frequency of market information for selected commodities and inputs;
- Additional services; and
- Financial sustainability, particularly how the MISTOWA project could be packaged for sustainability.

Approximately 7,000 people were contacted and their views collated. These consultations confirmed that farmers and traders lack access to timely (real-time) information on prices, sources of supply and demand, transportation and market conditions, among other things. They trade little beyond their limited geographic area, let alone with other countries. It also became evident that, in addition to accessing market information, farmers and traders also needed capacity building in collective action to improve their ability to bargain effectively. It was also important that the trade environment be conducive to free trade without harassment at the check points within and between the countries of West Africa.

Project objective

MISTOWA's aim was to increase regional agricultural trade and food security by improving regional efforts to generate, disseminate, and make commercial use of market information.

MISTOWA sought to alleviate three key obstacles to agricultural trade among countries in West Africa: (i) lack of timely access to

information on prices and market opportunities; (ii) inadequate organizational and business skills of producers and traders, which hinder their ability to respond to production and market opportunities; and (iii) unfavorable trading environments, including non-tariff trade barriers such as border harassment.

Project activities were designed to address these obstacles and contribute to the achievement of three corresponding Project Intermediate Results (PIRs):

- **PIR 1:** Improved market information generation and dissemination. The goal was to provide producers and traders with access to real-time market information by reinforcing existing public sector market information systems and developing a new private sector ICT-based system to facilitate intra-regional trade.
- **PIR 2:** Improved trader and producer skills. The goal was to build the organizational, technical and agribusiness skills of producer and trader organizations so that they are better able to identify and respond to market opportunities.
- **PIR 3:** Improved West African trade environment. The goal was to build the skills of producer and trader organizations to better advocate for an improved trade policy environment.

Strategy

MISTOWA used a three-pronged approach to:

- 1) Develop, in partnership with BusyLab's "TradeNet"² (www.tradenet.biz), an ICT-based market information service to provide real-time market intelligence;
- 2) Build the technical, organizational, advocacy and business skills of producers and traders to take advantage of market opportunities; and
- 3) Coach producer and trader associations in advocating for an improved trade environment, e.g., removal of non-tariff constraints.

In the market information component, MISTOWA provided grants worth US\$ 1.2 million to participating producer and trader associations to purchase computers and to procure Internet connectivity. It trained beneficiaries to use computers and cellular phones to upload content to TradeNet and to disseminate information from TradeNet to their members.

²Now rebranded as "Esoko" www.esoko.com

MISTOWA also helped the associations establish and run Agribusiness Information Points (ABIPs) in their markets and rural areas that served as meeting points, browsing centers, and training and business points; members can go to ABIPs to register their phones for alerts.

Some accomplishments and preliminary impacts

The project's scope was limited to increasing intra-regional trade in agricultural products. As a result, support was skewed toward traders – producers received limited direct support, especially

smallholder producers. Nevertheless, producers benefited from the project by participating in face-to-face events, such as trade fairs and training sessions that built their capacities to use cell phones to compare prices and seek buyers. They also received computers and Internet connectivity to establish and run ABIPs. Anecdotal evidence from MISTOWA beneficiaries suggests that access to real-time market intelligence information provides incentives for investments in agriculture by smallholder farmers (see Box 1).

Box 1:

Phoebe Usu “Madame Cassava”: Trader and Producer, DMDA, Kano, Nigeria*:

“I’m a widow, a mother of five with a BA degree and no job. Things were hard. Now, since I can do my business with modern communication tools through my involvement with MISTOWA, I’m better off taking care of my children. It depends on one’s capacity to understand and take good profit of what is offered.”

* “Madam Cassava” explaining the benefits she has reaped from the MISTOWA project at the official TradeNet launch in Accra, Ghana, May 12, 2005

Issa Keita, President of AMEPROC, Association of Malian Exporters in Agricultural Products, Bamako, Mali:

“Ever since we started using TradeNet services, particularly SMS alerts, our business has continued to grow. On February 28, 2006 our association concluded a trade for 20 tons of shea butter, valued at CFA 5,000,000 with Madame Aissata Bah of Senegal, and that is only one of several deals we have been able to conclude so far.” “AMEPROC has made good business from posting offers on TradeNet. In April 2006, we sold 150 tons of local maize valued at \$35,000 to a trader from Niger. In May we sold 80 tons of cashews valued at \$27,200 to a Senegalese trader. We recently sold 200 tons of shea nuts to a large Danish company, Aarhus Corporation and negotiating a memorandum of understanding for future supplies”.

By the end of the project:

- 12,500 beneficiaries³ from 15 countries in West Africa participated in MISTOWA events;
- Total donor investment of approximately US\$11,762,373 generated approximately US\$50,000 in agricultural trade value per beneficiary over the project period. Details are as follows.⁴
 - a. Total investment in the project (all sources)= US\$ 11,762,373
 - i. Staff salaries/benefits (25 project staff) = 15%
 - ii. In-country operations (6 countries) = 20%
 - iii. Direct project implementation cost= 43%
 - iv. Overhead= 22%
 - b. Total number of direct project beneficiaries= 12,500
 - c. Investment per beneficiary = US\$ 941
 - d. Total value of regional trade= US\$ 584,479,000
 - e. Total value of regional trade generated per beneficiary = US\$ 46,720
 - f. Total value of trade deals made and reported = US\$ 51,000,000
 - g. Total value of trade deals made per beneficiary= US\$ 4,080

³Composed of 33% producers, 38% traders and 29% others; 21% were women and 79% men.

⁴Funds contributed by all donors, from pre-design through implementation and closure, plus a 6-month bridge funding. Although one cannot attribute the value of agricultural trade per beneficiary solely to participating in the MISTOWA project, it nevertheless played a key role. Refer to the document of beneficiary testimonies.

The US\$ 51 million in trade deals (f) were reported voluntarily by beneficiaries. Considering that farmers and traders find it difficult to disclose their earnings for various reasons, it is impressive that this many reported. Even then, we estimate that for every deal reported, nine deals were unreported.

Accomplishments and preliminary impacts, including the results of telephone surveys about the impacts of the project, include:

- Support to BusyLab to further develop Tradenet.biz (now called “Esoko”). More functionalities and applications were added, and they were customized for user groups.
- More than 540,000 prices were uploaded, 406 markets set up, 3,109 users added, and 494 offers to sell or buy made online or with cellular phones. Not all the offer or bid alerts resulted in successful trade deals, as several deals were concluded at face-to-face events or through Internet contacts.
- More awareness of TradeNet/Esoko was created through the media, assessment missions, country visits, and presentations by project staff at different forums, which have generated interest in the use of the platform and could lead to scaling up across commodities and countries. These include:
 - A feature story on TradeNet and its use in Africa on CNN’s “Inside Africa” in March 2008.
 - Interest of the Government of Rwanda, through its Rwanda Information and Technology Authority (RITA), in the use of TradeNet following a presentation that MISTOWA staff made in January 2008.
 - Presenting TradeNet at the “Tech For Food” forum held in February 2008 in Paris, France.
- User surveys were carried out to assess and evaluate the impacts of the use of the platform. Major findings include:
 - More use of mobile phones: Producers and traders whose principal source of information was word of mouth now rely more on their mobile phones to receive market information.
 - Access to more useful and actionable information: Producers and traders interviewed cite real-time price

information, offers to buy and sell, and contacts of buyers and sellers as the most useful services provided through TradeNet/Esoko.

- Reduced transactions costs: Respondents who used TradeNet services, such as offers to sell or to buy or for comparing prices, reported that they had reduced the time it took to move a sack of maize from the farm gate to the retail market for the final consumer from an average of 42 days to 21 days (a 50% reduction).
- Increased proportion of the retail price for producers: Farmers who used TradeNet services, such as for offers to sell or to buy or for comparing prices, reported receiving 45% of the final retail price as compared with 22% for those who did not use TradeNet (a 100% increase).
- Increased business transactions: The use of TradeNet services to assess current prices, to send or receive price and offer alerts, and to contact buyers and sellers have all culminated in increased business for users. The survey indicated that 32% of producers and 22% of traders interviewed increased their business turnover by more than 50%.

Lessons learned

1) A thorough stakeholder consultation prior to project development is essential. The USAID/West Africa requirement of a 6-month, 1-1 cost share pre-project design phase for the competing teams was critical for MISTOWA’s success. It enabled us to conduct a critical situation analysis to identify the major constraints, partners, and stakeholders and to find collective and workable solutions to basic problems based on technologies that were already in the hands of most beneficiaries. It was derived from the “win-win” approach to partnership in which all the partners saw mutual benefits.

2) It is important to review and adapt strategies in the early stages of implementation. Our earlier “top down” approach of trying to work through the sub-regional producer and trader associations was abandoned because of huge administrative obstacles. We therefore adopted a more “bottom up” approach by dealing directly with the producer and trader associations at the country and district levels.

3) A public-private partnership with well-defined roles is important for success. MISTOWA presents a perfect example of a multi-level public-private sector partnership for empowering farmers and traders to sell more and buy better through access to market information. The major donor, USAID/West Africa, funded the project; Agriterra from the Netherlands bought in and provided additional funds to focus mainly on strengthening producer organizations and market access. The Hewlett Foundation provided funds to continue the project when the funding from USAID was interrupted. IFDC/MISTOWA partnered with a private software company, BusyLab, led by a British entrepreneur with a team of young African experts from Senegal, Benin, Togo and Ghana. BusyLab's role was to develop and refine the platform based on IFDC/MISTOWA feedback from users (farmers and traders). IFDC/MISTOWA used donor funds to train, equip and involve producers and traders from several countries to use the platform and also provide information from the field to populate the database. BusyLab and MISTOWA partnered with Global System for Mobile Communications (GSM) providers for mass dissemination of information by cellular phone, and are now in discussions with microfinance institutions to provide financing to registered users of TradeNet/Esoko.

4) Wider application – the approach is completely scalable.

TradeNet can be expanded to cover any number of commodities, countries and markets, provided the commodity associations and individuals are willing to provide content (prices, contacts, offers, news, etc.) to the platform. Scaling up of TradeNet and its wide use are possible and even helped by projections of the increasing use of cellular phones. The GSM Association projects that 85% of Sub-Saharan Africa's population will have GSM coverage by 2010. IFDC hopes to extend the application to provide business services and to link its supply side, enhancing projects with markets or demand-driven projects so that information is shared along the value chain and produce moves seamlessly from the farm gate to the markets.

5) Project duration was too short for any meaningful impacts, particularly on smallholder farmers. Given the current level of illiteracy and skills of producers and traders in Africa, the project duration (48 months from pre-design to closure)⁵ was too short to build the capacities of users and to promote the platform to

reach a level of sustainability. A project of this nature will require donor support for an uninterrupted period of 5–10 years to be sustainable.

6) With direct coaching and mentoring, trade associations added value to the training and ICT tools that the project put at their disposal to develop the ABIPs. IFDC/MISTOWA provided computers and Internet connectivity to trade and producer associations to train their members to use ICT tools for market access through the ABIPs. Project staff carefully monitored incomes and expenditures from the ABIPs and found a few of them, e.g., the Lagos Mile 12 Market Association, breaking even after only 6 months.

7) Smallholder farmers are most likely to benefit from the MISTOWA-type intervention if it focuses directly on them. The project was an intra-regional trade project and therefore skewed more toward traders. In the instances in which smallholder producers were directly supported to use the TradeNet platform to market their products, the results were excellent (they instantly found markets for their rice). Refer to the accompanying case study story "Mobile Phone Gives Lifeline to Vedenu Rice Farmers' Cooperative" (Box 2). In a post-project survey of beneficiary farmers, those who used TradeNet services, such as for offers to sell or to buy or for comparing prices, reported receiving 45% of the final retail price as compared with 22% for those who did not use TradeNet.

8) The MISTOWA intervention generated good value for donor investments. Project beneficiaries reported trade deals of US\$ 51,000,000 concluded as a direct result of MISTOWA. This translates into US\$ 4,080 per beneficiary or US\$ 4.33 for each dollar invested in the MISTOWA project.

Current applications and perspectives

IFDC continues to collaborate with BusyLab to refine TradeNet (rebranded as Esoko) and extend its application and business services to interested groups. IFDC is currently using the platform as a business communication tool among the various actors in the value chains of existing projects. For example, in the Agricultural Component of Ghana's Millennium Challenge Compact, which IFDC is implementing in the northern

⁵6-month pre-design phase funded for \$400,000 by IFDC and USAID, 36-month implementation phase funded for \$11,762,373 by USAID and Agriterra, and 6-month bridge funding for \$300,000 by Hewlett Foundation.

intervention zone, all 15,000 participating smallholder farmers that are being trained to increase productivity and entrepreneurship will be linked to input suppliers and marketing companies. Under the Ghana Agro-Dealer Development (GADD) project funded by AGRA and implemented by IFDC, more than 2,000 agro-dealers are being surveyed and their locations mapped by global positioning system. When farmer organizations and agro-dealers register their profiles on Esoko, they are better able to meet each other's business needs. For example, farmers will use the Esoko platform to communicate their input requirements to input suppliers before the season, receive extension and technical advice on their cell phones throughout the growing period, and communicate their product availability to marketing companies prior to harvesting.

In the "Linking Farmers to Markets (FTM)" project proposal that IFDC submitted to AGRA for funding, the Esoko platform will be the main market information system (MIS) platform, not only to provide traditional market information, but also to be used as a toolset to manage suppliers, buyers, transporters and others in the value chain. The project, with its marketing and market information platform, is also of interest to the project's partners and the AGRA-funded initiatives in Ghana (see Figure). For example, Savanna Seed Services Company Ltd. (SASSEC), a private seed-producing project, will produce high-quality

improved seeds for farmers in the three northern regions that will be tested along with best-bet soil fertility management practices disseminated by Savanna Agricultural Research Institute (SARI) in the implementation of the Integrated Soil Fertility Management (ISFM) project. Other productivity enhancing agricultural inputs will be made available to farmers through the AGRA-funded GADD project. The seeds, improved soil fertility management practices, and availability of other inputs from these initiatives will increase marketable volumes, which the FTM will help farmers market. This will provide an excellent example of AGRA program partnership in northern Ghana.

MISTOWA's implementing partners

MISTOWA's implementing partners include regional producer organizations (ROPPA and RECAO) and their national affiliates; regional trade associations and national affiliates in the agricultural subsector (ROESAO and FACIA); regional networks of MIS in the public sector (RESIMAO); technical partners (Busylab, Geekcorps, CILSS and Agriterra); sub-regional economic and policy institutions (ECOWAS and UEMOA); and NGO organizations such as Afrique Verte.





USAID | WEST AFRICA

CASE STUDY

Mobile phone gives lifeline to Vedenu rice farmers' cooperative

Tradenet platform (www.tradenet.biz) opens wider market opportunities for farmers and traders in West Africa



"Until I attended the training, I never realized my cellular phone could be an important and low-cost business tool in my pocket. The cell phone has indeed given us a lifeline and negotiating power as we face today's competition"

Gabby Awumee, Secretary, Vegbegbe Vedenu Rice Farmers' Cooperative and member of Hohoe District Alliance of Farmer Based Organizations

Challenge

The lack of access to timely and reliable market information has been a perennial barrier to trade and food security. The Vegbegbe Vedenu rice farmers, like several other farmers and farmer groups in developing countries, face a problem of finding markets for their produce: they produce without knowing where, to whom, and at what price to sell to make reasonable returns on their labor.

Initiative

A USAID/WA-funded MISTOWA project helped to pilot "TradeNet", an internet application that allows users to access information on market prices, and contacts of buyers and sellers via the web, email and mobile phones. Tradenet was developed in partnership with BusyLab, a private Ghana-based software company. The project trained over 6,000 producers and traders from 90 organizations in West Africa to use the mobile phone to request prices and to post offers to sell or buy produce and inputs. Associations can also create their own web sites, "profiles" within the TradeNet site which they can use for information exchange. During one such training session in the Hohoe District of the Volta Region, the association secretary Gabby Awumee created a profile for the Vegbegbe Vedenu Rice Farmers' Cooperative and posted an offer by mobile phone to sell 120 tons of paddy rice on behalf of the cooperative.

Results

Within hours of posting the offer, Mr Awumee received 26 phone enquiries from Ghana, Burkina Faso and Togo. The deal was finally concluded with a local milling company, Marsello & Co, from Kpong in the Eastern region of Ghana, whose representatives traveled to Hohoe to buy 100 tons of paddy rice, estimated at \$36,000. Other producer organizations and individual farmers have reported similar successes after receiving training. Through SMS alerts received on their cell phones, a producer association in Kara (northern Togo) found a soybean buyer in Lome, and concluded a deal worth \$6,029. A tomatoe producer in Togo found a buyer in Cotonou, Benin, and concluded a deal worth \$1,488, and an African entrepreneur in Paris, France responded to a shea butter sales offer posted by a Malian producer association AMEPROC and concluded a deal worth \$624,264. These successes have sparked interest among farmers and farmer groups. To meet this demand, BusyLab and IFDC have begun piloting a "TradePoint" concept where several "TradeAgents" are posted in different markets and rural areas to provide direct services using their cell phones.