

Agriculture for Development–Revisited

Lessons learned from the University of California at Berkeley conference
October 1 and 2, 2010

Prepared by Derek Byerlee, Alain de Janvry, and Elisabeth Sadoulet

Agriculture for development in the WDR 2008 and beyond

The objective of the Berkeley conference, “Agriculture for Development–Revisited”, was to take stock of the state of affairs in using agriculture for development three years after release of the World Development Report-2008 on the same subject (World Bank, 2007). This note is to provide a summary of some of the main lessons learned in this exercise. These lessons are meant to serve as background for new approaches, investments, and research initiatives in using agriculture for development.

The World Development Report 2008, *Agriculture for Development*, was a successful initiative in terms of process (building a broad consensus), product (large number of copies printed and downloaded, and extensive press coverage and citations), and outcomes (correlations with major changes in policies and programs directed at agriculture and food security, with no claim of causality else than frequent reference to results found in the WDR 2008). Interest in the Report was undoubtedly enhanced by the 2008 food crisis with its high economic, welfare, and political costs, and by rising international concern with unabated hunger contradicting the first Millennium Development Goal. With current tumultuous events in food and agriculture, the continuing reality of food price instability, and considerable uncertainty about the future, interest in revisiting the agriculture-for-development theme is undoubtedly high (Dethier, 2010).

Much has changed of course since the Report was released in October 2007. With the food, financial, and climate crises, a dominant concern has been increased exposure to shocks enhancing food insecurity and vulnerability to poverty. Responses to these events have taken new forms, in particular massive private investments in agriculture attracted by favorable markets, an international race to access land, protectionist policies disrupting international trade in food staples, revival of large scale subsidies to agriculture in the name of food self-sufficiency, large public and civil society commitments to increased spending on agriculture, and expansion of social safety net programs to shelter the poor from price volatility and improve their access to food.

Revisiting how to use agriculture for development in light of the rather dramatic events that occurred in the intervening period and of heightened concerns with the future of food and agriculture was thus the motivation for this stock-taking exercise. The overall context was one of considerable excitement about the new opportunities offered by agriculture for business, growth, and social development, and at the same time recognition of the enormity of the challenges to seize opportunities and make them into realities. We focus here on eight lessons derived from the conference that have implications for the future use of agriculture for development:

1. How to use agriculture in support of a structural transformation of the economy under heterogeneous conditions? Implications for the formulation of country strategies.
2. Is the capacity of agricultural growth to reduce poverty changing? Implications for an integral approach to rural development.
3. How to manage price volatility and achieve food security? Implications for price stabilization vs. risk management and risk coping.
4. How to address the renewed large farm-small farm debate? Implications for complementarities between farm types.
5. How to overcome the adoption gap in agricultural technology for smallholders? Implications for focusing on first-order barriers.
6. How to identify new approaches to rural development? Implications for scalability and sustainability.
7. How to measure the development impact of technological and institutional innovations? Implications for the design of evaluations.
8. How to proceed with implementation? Implications for strategies, discovery, and training.

In the end, the revisit stresses the need for three categories of initiatives to turn opportunities into development achievements: (1) Using agriculture for development is a highly complex undertaking that requires developing comprehensive country-level strategies; (2) extraordinary new opportunities exist in investing in agriculture for development, but more systematic efforts need to be made in discovering and demonstrating what works; and (3) enhanced implementation capacity in this complex undertaking is necessary for success, requiring strong investment in capacity building in using agriculture for development.

1. How to use agriculture in support of a structural transformation of the economy under heterogeneous conditions? Implications for the formulation of country strategies

The main message from the WDR-2008 was the need to invest more and better in agriculture in order to capture the many contributions that agriculture can make to development: a source of growth and structural transformation for the agriculture-based countries, the narrowing of rural-urban disparities especially in the transforming economies, poverty reduction given the 75% prevalence of the rural poor in world poverty, enhancing food security, resource saving to the benefit of sustainability in agriculture, and the provision of environmental services across all economies. The message came in the context of widespread neglect of agriculture by governments and donors over a 25 year period starting with responses to the debt crisis of the mid-1980s, and of mounting symptoms that the neglect of agriculture was having huge economic, social, and environmental costs.

Intervening events since 2007 have reinforced the importance and urgency of this message, in particular as a consequence of the triple food, financial, and climate change crisis. Multiple responses in the intervening period demonstrate widespread recognition

of the renewed importance of agriculture as a sector of opportunities for private and social gains: increasing donor contributions in particular from the G8 through the Global Agriculture and Food Security Program and from the World Bank Group, civil society engagements such as the Gates and Rockefeller Foundations supporting the AGRA initiative (Traxler, 2010), public sector commitments to agriculture with more African countries meeting the NEPAD 10% public spending target, and huge increases in private sector investments in agriculture of both domestic and foreign origins. From the widespread perception of agriculture as a sunset industry, the sector has now become a frontline opportunity for business and development. Agro-pessimism has given way to widespread agro-optimism, recognizing of course that it is only one sector in broader strategic frameworks for growth and development, and that the ultimate goal of agricultural growth is not self-serving but to support a structural transformation of the economy toward diversification (Lin, 2010a).

New opportunities for success in investing in agriculture have emerged, with the generalization of sound macro-fundamentals, profitable new markets for both low and high value products, integrated value chains often at a regional and global scale, technological revolutions (most notably in information technology and the omnipresence of mobile phones), and institutional innovations (especially new financial products in savings and insurance, contracts between producer groups and commercial partners, multi-stakeholder coordination in whole value chains, new business models to tap private investments, and the decentralization of governance).

At the same time, it is evident that the agriculture-for-development mission remains substantially incomplete. Hunger has not been declining, vulnerability to poverty has increased, structural transformations of the African economies have not been achieved in spite of extensive rural-urban migrations and in some cases mineral export-led growth, aggregate land productivity remains stagnant (with notable exceptions, especially in Western Africa), and resource scarcity and degradation have continued to worsen. This is perhaps because renewed efforts and resource commitments are too recent to have borne fruits, but perhaps also because we need to explore new ways of better approaching the problem and implementing solutions.

The context for the re-visit was thus one of considerable excitement for the attention given to the theme of agriculture for development, the convergence of interests in the subject by multiple actors, and the numerous emerging opportunities to use agriculture for development more intensively and better than in the past. At the same time, there are evidently very high risks of failure to succeed due to deficits in knowledge, capacity, and governance, even assuming that resource commitments will be met.

Of concern, in particular, is to clearly establish when investing in agriculture for development is a priority for a successful structural transformation of the economy (Lin, 2010b). We know that here is considerable heterogeneity of conditions across countries and regions within countries. When food is non-tradable, investing in agricultural productivity is essential for growth (as food prices determine labor costs) and for food

security (Gollin, 2010). When food is tradable, other options including export-oriented agriculture may exist according to comparative advantage. Knowledge of when to prioritize agriculture is thus essential and it would be wrong to believe that it is the universal solution. Once this is established, capacity to implement and the role of the state in investing in and regulating agriculture must be defined (Harrison, 2010). Deficits in capacity and governance may make the agriculture-for-development approach fail.

There is also an issue of short run responses to political demands vs. long term uses of agriculture for development. Renewed interest in agriculture, driven by the food, financial, and climate change crises, has diverted expenditures on food and agriculture toward short run concerns with food security. This includes interventions to cheapen food for consumers (such as tariff reductions, price controls, export taxes, export bans, and building up government stocks), social safety net programs (school meals, conditional cash transfers to the poor, targeted food subsidies, and food for work programs), and producer subsidies for quick supply response (seed and fertilizer subsidies for land intensification). This has occurred at the cost of investments for the long term use of agriculture for development. Compromised are efforts to spur agricultural productivity (generation and adoption of new technologies), improve linkages from farmers to markets through better infrastructure and marketing services, reduce risk and vulnerability for farmers, facilitate labor entry in and exit from agriculture, add value to agriculture in rural non-farm activities, and enhance environmental services and sustainability, i.e., the investment program proposed by the WDR2008.

Using agriculture for development is far from straightforward and universal. Agriculture-for-development strategies need to be developed at the national level on a periodic basis to provide vision and guidance for investment in agriculture. Considerable progress has been made with CAADP in Sub-Saharan Africa and with the comprehensive agricultural strategies that nations must develop to qualify for development assistance (e.g., for the new Global Agriculture and Food Security Program (GASFP)). This effort needs to be consolidated in two dimensions: strong evidence-based assessments of current progress and new opportunities; and participatory processes in defining strategy papers in using agriculture for development.

A proposition to do this would require two steps. First, the preparation of “Agriculture for Development Assessments”, by analogy with the now universal Poverty Assessments based on systematic data collection and rigorous analyses. Second, the preparation of “Agriculture for Development Strategy Papers”, based on the above assessments and extensive participatory processes, by analogy with the ubiquitous Poverty Reduction Strategy Papers (PRSP). The agriculture for development strategy papers would importantly help better place agriculture in the PRSP process where they are typically poorly understood and badly neglected. It would build on what is already done by CAADP and the country comprehensive agricultural strategies. This approach could be piloted at the level of a few countries where there is strong interest in advancing the use of agriculture for development.

2. Is the capacity of agricultural growth to reduce poverty changing? Implications for an integral approach to rural development.

GDP growth originating in agriculture has been heralded as being particularly good for poverty reduction. A key result presented in the WDR is that GDP growth originating in agriculture is 2 to 3 times more effective at increasing the consumption expenditures of the poor than GDP growth originating in the rest of the economy. This has been invoked as a major reason to invest public resources in agriculture. But this may be changing. World poverty is still predominantly rural, but populations are becoming increasingly urbanized, carrying with them poverty to the urban environment.

In a provocative paper, Ravallion (2010) showed that not only is lower initial inequality good for a more pro-poor growth—something that has been recognized for some time, e.g., in the WDR 2006 on *Equity and Development*—, but also that lower initial relative poverty makes growth more pro-poor. Here, the degree of pro-poorness of economic growth is measured by the elasticity of poverty reduction with respect to growth. The pathways through which this occurs remain to be established, but hints are that it may have to do with greater ability of at least a segment of the poor to seize economic opportunities, resulting in more inclusive growth: a lower initial poverty rate allows them to capture a higher share of the gains from growth as long as inequality does not rise too much. For agriculture, this suggests focusing on land reform (China's household responsibility system that distributed access to land very equally), access to capital for the poor, and universal access to education to reduce initial poverty, a policy package that secured pro-poor growth in post-War Taiwan Province of China and the Republic of Korea as uncovered by Adelman (1978) in her redistribution-before-growth strategy.

Using data for India, Ravallion confirms that, consistent with the WDR 2008, rural growth was much more effective at reducing rural and overall poverty than urban growth before 1991. Since 1991, however, this appears to have changed markedly. Urban growth has become more effective at reducing overall poverty. The other interesting result is that urban growth appears to be equally effective at reducing rural poverty than it is at reducing urban poverty. Urban growth is thus now more pro-poor, and the pattern of growth matters less than in the past since urban growth is poverty reducing across the whole economy.

The implication for rural poverty reduction is important. Foster and Rosenzweig (2010b) present new results for India according to which increasing farm size is key for improved incomes in agriculture because it allows for the use of mechanization that has indivisibilities (with differences in access to credit by small and large farms favoring the latter), implying increasing returns to scale and higher profitability per hectare. Today, most farms in India are too small to exploit the productivity and cost-saving advantages from mechanization. But land consolidation in larger farms with continued population growth and limited long-distance migration requires vigorous employment creation in the rural non-farm economy, basically in secondary towns and cities.

The growth of employment in these towns is linked to agriculture but also importantly to urban growth. Himanshu, Lanjouw, Mukhopadhyay, and Murgai (2010) find that employment growth in the rural non-farm economy (RNFE) is strongly correlated with growth in neighboring urban centers. This opens important new perspectives where much greater focus has to be given to the promotion of the RNFE in the small towns and cities of rural India for future poverty reduction, a much neglected sector of economic activity. A successful RNFE will allow both land concentration and poverty reduction in rural areas, and will benefit from the poverty reduction capacity of urban growth as it propels pro-poor growth in secondary towns.

Where there is rising land scarcity due to continuing rural population growth, the RNFE provides a key escape to poverty and an instrument to allow exit from farming and an increase in farm size. There are however contradictory interpretations of the source of dynamics of the RNFE. The traditional interpretation (Mellor, 1976; Adelman, 1984) is that the RNFE economy emerges through linkages with agriculture. Successful agricultural growth breeds a growing RNFE through forward, backward, and final demand linkages, located in rural areas due to the advantages of proximity to agriculture. An alternative interpretation looks at the rural labor market (Foster and Rosenzweig, 2004) as the source of attraction for roving firms looking for cheap labor. In this case, the RNFE is favored by lack of employment opportunities in agriculture. Agricultural growth would enhance employment in agriculture and lift rural wages, deterring the RNFE. As opposed to complements in the classical models, agriculture and rural industry are here substitutes. Finally, the RNFE can also be the product of decentralization of economic activity toward small and medium cities (Himanshu, Lanjouw, Mukhopadhyay, and Murgai, 2010). In this case, infrastructure and clustering of economic activity in rural areas linked to urban centers is the key to a dynamic RNFE. Clearly all sources of RNFE dynamism are possible, but they each respond to very different policy channels that must be clearly identified.

Using agriculture for development thus requires an integral perspective, where not only smallholder-based agricultural growth is sought (through land productivity gains in small farms, as proposed in the WDR), but also land consolidation in larger farms that can own or rent machinery, labor force exit from agriculture, and correspondingly rapid employment creation in the rural non-farm economy. Growth in agriculture and in rural non-agricultural activities (not only linked to agriculture but also to urban consumption growth) will thus increasingly be the cornerstone of future successful rural poverty reduction. Moving from a sectoral to an integral territorial perspective has profound implications for the way policy is made in using agriculture for development.

3. How to manage price volatility and achieve food security? Implications for price stabilization vs. risk management and risk coping

While food prices have declined from their 2008 peak, there is broad agreement that past sources of price instability have not been removed and that repeats of food crises are likely. Destabilization of climatic patterns, unilateral trade interventions in food markets with export bans and over-stocking, potential upsurges in energy prices,

increasing links between food and energy markets, and investment funds seeking speculative gains in commodity markets can all be sources of future price volatility, as they have been in the past. Price transmission between domestic and international markets has been overall surprisingly low, uneven, and difficult to explain (Martin and Anderson, 2010). This has implications both in insulating markets from international price movements as desired by politicians, but also in reducing stabilization of domestic prices when there are localized food production shocks, likely to increase with the acceleration of climate change. Beggar-thy-neighbor policies have not been seriously addressed as international coordination in managing responses to food price shocks remains essentially non-existent. Political pressures toward food self-sufficiency and anti-trade positions (e.g., as clearly advocated by the widely endorsed IAASTD) may contribute to worsening the quest for a solution as opposed to helping it. Universal food price subsidies, as pursued in most Middle-East and North Africa countries, have large fiscal costs for limited benefits. And land purchases abroad to secure food security may not be immune to political interventions in the context of crises (Wright, 2010).

The food crisis has shown the extraordinary social, economic, and political costs that food price spikes can have. That lesson has been learned, the hard way. Reducing price volatility and enhancing food security for the poor has risen to the top of policy agendas, for example for the G20 in the coming year. What needs to be improved is the design of comprehensive country strategies that combine the many instruments that can be used to achieve food security (as for example done by Brazil under its successful Zero Hunger strategy), and coordination of international responses to prevent repetition of these negative events.

At the national level, reducing exposure to food price volatility can be achieved through three categories of policy instruments: instruments to reduce the eventuality and size of price shocks, to manage risk ex-ante relative to price shocks, and to cope with risk ex-post relative to price shocks. Policy interventions can be of two types: interventions through the performance of markets, and direct state interventions. This gives the following six categories of policy interventions at the national level shown in Table 1.

Policy instruments	Ex-ante relative to price shocks		Ex-post relative to price shocks
	Reduce the eventuality and size of price shocks	Risk management	Risk coping
Interventions through markets	Make markets work better in time and space Information on production and stocks Market intelligence Decrease transactions costs (infrastructure) Trade liberalization Increase competition Futures markets, put options	New financial products Crop/livestock insurance (index-based) Savings instruments and incentives to save	Emergency loan programs
Direct state interventions	Intervene in markets Public food reserves Trade interventions, price bands	Enhance productivity in smallholder farming Resilience of production systems Production for home consumption Local purchase for social programs Input subsidies Employment in the rural non-farm economy Decentralization, rural investment climate Small and medium rural enterprise programs	Social safety nets for vulnerable (quick response) School meal programs Cash and food transfers (vouchers, CCT) Workfare, productive safety nets Prevent decapitalization of productive assets

Table 1. Policy instruments and types of interventions to achieve food security in the context of price volatility

What Brazil's Zero Hunger program has shown is that eliminating hunger and achieving food security requires putting into a place a multi-sectoral strategy that

coordinates a large array of instruments. Some of the important entry points in Table 1 that deserve greater attention are: (1) The use of new financial products for risk management. This includes improved access to safe and inducive savings instruments and innovative index-based agricultural insurance products. (2) Enhanced factor productivity in smallholder farming for both home consumption when there is a shock and for income generation. Yields in subsistence farming have a large margin for improvement. While production for home consumption is not a pathway out of poverty, it may be one of the most cost effective food security instrument for rural populations in poor countries with limited fiscal and administrative capacity to manage social safety nets. (3) Quick response social safety nets for risk coping. While social safety nets have been effective for chronic poverty, they need to be adjusted to handle transitory poverty and the associated risks of irreversibility in child health and education and in asset decapitalization. This requires innovative approaches when people at risk are working in the informal sector or are self-employed, making symptoms of distress more difficult to identify than loss of employment in the formal sector.

Efforts have been made to improve global information and coordination in managing price volatility. The World Bank has set up a Food Price Watch series that tracks information on domestic food prices in low and middle income countries. The World Committee on Food Security has been revamped by the FAO, IFAD, and the WFP with extensive international support, but its capacity to coordinate donors and influence policy is still to be demonstrated. Increased global stocking can also be encouraged, although coordination of a global physical food reserve is probably illusory. Important is to enhance low income food dependent countries' access to agricultural financing facilities so they can use the international markets when hit by a food shortage.

In general, what we have seen is more progress with poverty reduction than with hunger abatement, both part of MDG1. Food security is thus demonstrably more difficult to achieve than poverty reduction. Reducing hunger is a complex and multidimensional problem that requires comprehensive strategies at the national and global levels that are difficult to put into place and to remain performing when crises hit. It also requires exploring new approaches such as productive safety nets that combine immediate relief with investments in long term resilience of food security to price and income shocks.

4. How to address the renewed large farm-small farm debate? Implications for complementarities between farm types

Rapidly growing demand for food and feed in the transforming economies and rising world market prices have created highly attractive investment opportunities in agriculture, unleashing a rush of investments in eventually very large corporate farms. Examples are farms of 600,000 ha for palm oil production in Malaysia and Indonesia, 300,000 ha for sugarcane-ethanol in Brazil, 600,000 ha for grains and oilseeds in Argentina often held as rented lands in *pools de siembras*, and 1 million ha for cereals in Russia and Kazakhstan (Deininger and Byerlee, 2010). While the small farm-large farm debate is quite ancient, and usually concluding that there are no inherent economies of scale in agriculture other than for plantation crops, new sources of economies of scale

have emerged. These originate in technological change (management techniques, precision farming, and new technologies such as zero tillage and GMOs), new markets (product certification especially increasingly demanding Sanitary and Phyto-Sanitary standards, contracts with supermarket chains for large continuous and uniform deliveries), institutional changes (access to international finance and re-insurance), and public-private partnerships in the provision of public goods (infrastructure for access to low populated areas and opening of new lands when pure public goods are in insufficient supply). However, too often the large farm advantage has been due to market failures, institutional gaps, and policy distortions that are farm-size specific, creating biases against the competitiveness of smallholders, while there are no true economies of scale and perhaps diseconomies due to the advantages of self-supervised family labor. Eliminating these biases can often restore the competitiveness of family farmers. This can be achieved not only through state interventions but also through collective action, for example by different forms of producer organizations.

Emergence of large farms in developing country contexts, especially sub-Saharan Africa, can be fraught with risks (Deininger and Byerlee, 2010). One is weakness or absence of property rights over land which gives leeway to state authorities to expropriate and contract out without warning and compensation for current users. The other is lack of transparency in land deals, with no publicly available information on the terms of contracts, payment of rents or sales prices, and disposition of the revenues collected. Capacity to negotiate and write a contract is generally deficient, with lack of legal services to provide guidelines. Subsequent land use is not subjected to regulatory procedures, in particular regarding labor and environmental standards. As pointed out by Deininger and Byerlee, there is a clear need for international monitoring of these events and provision of guidelines to countries regarding best practices. This again calls for coordinated action to inform, regulate, and provide expertise.

Given the potential advantages for countries to tap the capital, technology, and market access offered by keen large scale private investors, an interesting option is to seek mutually beneficial complementarities between large and small farms. This can be based on a division of labor along the value chain. It can be for joint membership in cooperatives where large farmers play entrepreneurial roles (e.g., in the San Francisco Valley in Brazil) that benefit small farmers in accessing technology and markets. Land leases to large farmers in Morocco and Senegal (Maroc Plan Vert, and Senegal PDMAS in the Fleuve Delta) imply a tutelage or a coexistence between large and small farmers, with expected beneficial spillover effects in technology and marketing. The possibility of symbiosis or coexistence between large and small farms is an option that requires much greater attention, with public assistance targeted at favoring these arrangements. But this will not happen without innovative search for complementarities and coordination among parties.

Total factor productivity, and in particular land productivity, has remained stagnant in Sub-Saharan Africa. Yet, we know that productivity has to rise if food prices are not to increase, poverty is to be reduced, and land degradation reversed. This is particularly crucial as horizontal expansion is exhausted in many countries, especially for

smallholders. This has motivated the quest for a Green Revolution for Africa (AGRA) with significant funds committed by many donors.

Under-investment in agricultural research has been widely documented by calculations of rates of return to investment in research that show excessively high returns relative to opportunity cost. Under-investment is particularly severe in Sub-Saharan Africa, coming from both public and private sources. There is, however, an additional problem to be solved in the case of Africa, which is the presumed existence of a backlog of technologies available for adoption that remain unused or inefficiently used, resulting in a large gap between potential and actual yields. This “adoption puzzle” has been the object of much attention in recent years, including the Gates-Berkeley-MIT ATAI (Agricultural Technology Adoption Initiative), but it remains largely unresolved.

An important deficit in understanding the “adoption puzzle” is availability of a solid diagnostic of the state of adoption of new technologies such as fertilizer and seeds in Sub-Saharan Africa (Brooks, 2010). This is still largely missing, in part because it is not so easy to do. Recognizing seed varieties in the field is quite difficult, so that characterizing adoption is not a simple matter. As Gollin (2010) says, “the current generation of improved varieties is not so easily identified. Nowadays, we are often trying to distinguish between one generation of improved varieties and a previous generation. Are farmers growing the “old” hybrid maize, or a “new” hybrid maize? ... It is not clear that farmers themselves can accurately tell you what varieties they are growing. Even where they purchase seed, the nature of seed systems in Africa is such that they may not know with any accuracy what variety they are growing”. Monitoring seed adoption may thus require DNA testing as opposed to simply asking farmers. Information on relative fertilizer to product prices at the farm level or in local markets is sparse, even though this is likely the main simple indicator of the profitability of adoption. A major effort should thus be made to characterize the state of adoption of major technologies presumed to be lagging such as fertilizers and seeds, and provide simple correlates with conditions of use such as agronomic conditions, relative prices, availability of information, and security of property rights.

Efforts have been made to explore causalities in lack of adoption or inefficient use (ATAI, 2010). Causal factors that have been explored include the following:

(1) **Expected profits from adoption** given soil and climate conditions, transactions costs on markets, and volatility of prices over time and space. This is certainly a determinant of first-order of importance (Foster and Rosenzweig, 2010a; Udry, 2010). We know that there exists considerable heterogeneity in conditions of use, with in particular huge transactions costs due to weak infrastructure. If for example a fertilizer-maize price ratio above 6 (i.e., the farmer needs to sell more than 6 kg of maize to buy 1 kg of fertilizer) is a threshold beyond which fertilizer adoption is not profitable, we find that 44% of the farmers in Malawi, located too far from a road, are excluded from profitable fertilizer use. Yet, careful mapping of expected profitability of adoption across time, space, and categories of farmers is largely missing. The expectation is that in fact adoption may not be profitable for a large segment of the smallholder population,

given agro-ecological conditions and prevailing prices and transport costs. As a result, “non-adoption may be optimal in more cases than we think” (Brooks, 2010).

(2) **Information and learning.** Much work has been done on this, with emphasis on the role of gaps in awareness due to incomplete access to information, the role of individual learning (learning by doing, the key role of education in learning), and learning from others (through spillover effects, social networks, and traditional institutions). The rapid spread of cellular phones offers new possibilities of bridging the information gap (Aker, 2010). However, individual learning remains limited by low educational levels. And social learning is influenced by the structure of traditional institutions such as gender segregation in social networks.

(3) **Market failures in credit and insurance.** Much work has also been done on this, and there is a better understanding of institutional gaps in providing financial services. Yet, much remains to be done in adapting financial institutions to the smallholder clientele whose adoption may be lagging. This includes not only access to loans while the microfinance revolution is still insufficient for agriculture, but also safe savings facilities, affordable insurance, and low cost and secure financial transactions.

(4) **Public goods such as rural roads and security of property rights.** These can be hugely important, affecting in particular expected profits from adoption. Yet, these determinants of adoption have received relatively little attention.

(5) **Behavior such as time inconsistency.** While there are fascinating patterns of behavior that indeed limit adoption, suggesting the need for institutional innovations to assist decision-making, careful attention must be given as to how far these innovations will go in inducing adoption at a significant scale

In the end, the road to progress in cracking the “adoption puzzle” may be twofold. One is the need for a comprehensive diagnostics of the state of adoption of technology in Sub-Saharan Africa with attention given to heterogeneity of conditions, including estimation of simple correlates of non-adoption with such variables as farm gate relative prices, soil and climate conditions, market imperfections, and local institutions. The other is focusing priorities in the identification of causalities toward barriers that appear to be of first-order of importance in solving the adoption puzzle in order for the derived policy interventions to potentially have a significant impact on the scale and sustainability of productivity gains.

6. How to identify new approaches to rural development? Implications for scalability and sustainability

Post-2007, donors signaled their agreement that agriculture deserves more investment and that food security and hunger (with global failure of the MDG1 on hunger) need more attention. This was manifest at the 2009 G8 meeting in l’Aquila, Italy, where countries pledged \$22 billion for investment in agriculture. Commitments may of course not be additional money (only \$4 billion is additional according to Oxfam) and may not be met as the financial crisis tightens fiscal budgets. To date, only \$1.2 billion has been disbursed (Oxfam, 2010). But, even if resource commitments are honored, do we know how to spend the money effectively in using agriculture for development? The

profession is sharply divided on this. It is also sharply divided as to which approach would be most effective.

The most visible split in proposed approaches is between the WDR 2008 and the IAASTD (International Assessment of Agricultural Knowledge, Science, and Technology). While the two perspectives have much in common, in particular regarding the central role of the competitiveness of smallholder farming in using agriculture for development, they also have fundamental differences that led some private sector companies to withdraw from the Assessment and Australia, Canada, and the USA not to endorse the final report. It has, however, been broadly approved in other circles with 58 governments agreeing with its conclusions as well as numerous NGOs (such as Action Aid and Food First) and producer organizations such as Via Campesina. The main points of contention between the two perspectives are about science, trade, and choice of crops: the IAASTD favors agroecology and traditional knowledge while the WDR proposes a broader array of scientific approaches including prudent use of GMOs; the IAASTD proposes access to food based on national food self-sufficiency and the right to food, while the WDR proposes reliance on comparative advantage and trade, though with food security concerns; and the IAASTD recommends focus on food crops for self-sufficiency, while the WDR suggests food and cash crops based on risk-discounted income generation potential. The WDR position is that feeding nine billion people by 2050 without major environmental damage will require precautionary mobilization of science on all fronts, trade to capitalize on comparative advantages and to manage local production shocks associated with climate change, and smallholder participation in value chains for low and high value commodities as an important pathway out of poverty. It is, in our opinion, urgent that useful bridges be built between these two positions to jointly address the huge task of feeding the world while eradicating poverty and achieving environmental sustainability.

The quest for how to best use agriculture for development needs greater attention and rigorous experimentation and learning. Highly creative new approaches to rural development have been introduced. Two were explored in the revisit: contracting between smallholders and commercial partners in high value food chains (Swinnen, 2010), and the use of ICT for agricultural extension (Aker, 2010).

The WDR put strong emphasis on opportunities offered by the rapid growth of markets for high value commodities such as horticulture, fruits, cut flowers, poultry, milk, and fish products, and this for both domestic markets (agro-industry, supermarkets) and non-traditional exports. Because these commodities make intensive use of both land and labor, they match the factor endowments of smallholder farmers, offering the promise of income gains if they can compete in these value chains. Success has, however, been limited. In Latin America (Colombia, Bolivia, Ecuador, Peru, Guatemala), “productive alliances” have been promoted with some success, consisting in inter-linked contracts between smallholder producer organizations and commercial partners, assisted initially by project-funded support organizations. Interlinked contracts can help overcome the market failures in credit, insurance, technical assistance, and infrastructure that limit the competitiveness of organized smallholder farmers. The main challenges with the

productive alliances approach have been: (1) in achieving discipline in collective action for the producer organization to meet the terms of the contract while inducing members to resist the temptation of side-sales, particularly when prices are rising and local markets exist for the contracted product; (2) in preventing the hold up problem whereby the commercial partner, often with monopsony power, reneges on the contractual agreement once the crop is ready for delivery, offering less favorable terms of purchase or imposing higher quality standards; and (3) in securing sustainability of the contractual arrangements beyond the short period of project support, that depends importantly on availability of other sources of institutional support such as NGOs and second-degree organizations, and in third-party certification for contract enforcement.

In Sub-Saharan Africa, the effort to integrate smallholder farmers to high value chains has focused on consolidation of the whole value chain due to weakness of available commercial partners. Major difficulty in participating to markets for non-traditional exports is in meeting SPS requirements that have become increasingly stringent. This has led to collapse of many smallholder outgrower schemes such as supported by DrumNet in Kenya. In Senegal, as documented in the WDR, expansion of green bean exports has increasingly shifted from outgrower contracts to vertical integration due to difficulties in achieving value chain coordination to meet SPS standards. Whether producer organizations can offer a “third way” other than outgrower contracts with large farmers and vertical integration remains an ongoing challenge. Recent expansion of EurepGap certification to producer organizations offers a new promise for smallholder participation. Value chain weaknesses remain in infrastructure investments and in the enforcement of contacts between commercial partners and exporters, justifying the whole value chain approach.

Access to mobile phones has exploded in sub-Saharan Africa, demonstrating ability to adopt massively and rapidly a technological innovation when sufficiently attractive. In Africa, over 60 percent of the population now has access to mobile phone coverage. Adoption has reached poor and illiterate people. This is because phones fulfill many useful functions in consumption and earning, many of these benefits are tangible and immediate, use does not require literacy and can be learned quickly from others or be assisted by intermediaries, the investment can be shared with many others, and the service reaches at equal cost in central and remote rural locations. Applications allow technological leapfrogging in accessing such services as mobile banking, information on market prices, technological advice from expert public or private services, medical consultation, warnings on exposure to risks of insecurity, and political mobilization. Potential applications to technology adoption are truly stunning, and still poorly exploited. The quality of services provided over the phone must be improved and adapted to local needs and understanding, and trust in providers of information must be established. There has been a rapid sequence of improvements in services from which much needs to be learned and opportunities to experiment to improve them exist (Aker, 2010).

As we experiment with new approaches, a key issue is how to internalize in improved project design the lessons learned from experimenting. A suggestion (Ligon

oral communication at the conference) is for donors to routinely demand from project proposers (and the associated researcher) formulation of a formal model that incorporates current knowledge to predict expected outcomes. As lessons are derived from successes and failures in project implementation, the model is constantly updated to always be at the frontier of knowledge. This discipline of Bayesian model updating would help capitalize on lessons learned to improve project designs toward scalability and sustainability. This discipline of model updating based on lessons learned should be an equal requirement for project funding as impact evaluation of project outcomes has increasingly become.

7. How to measure the development impact of technological and institutional innovations? Implications for the design of evaluation

In recent years, the development economics profession has been steering its way through a “rigor revolution”, seeking to go beyond the estimation of correlations with “determinants” of outcomes to the identification of causalities. The latter is a *sine qua non* for policy recommendations to derive from the analysis. This transition is largely incomplete, but it makes obsolete many poorly identified past evaluations and policy messages. In this difficult transformation, the profession needs to progress from unreliable relevance to relevant rigor. This applies to impact evaluations of the role of agricultural technology for development.

As we well know, measuring accurately the causal effect of technology adoption on outcomes such as poverty reduction is quite demanding due to the difficulty of defining a valid counterfactual and of keeping track of outcomes as they diffuse over time and space and create general equilibrium effects. There are unfortunately no simple recipes. Each case must be analyzed for its own idiosyncratic features and a corresponding identification strategy defined. Impact evaluation is not a set of recipes, but an art requiring deep understanding and creativity. Yet, much of past practice in impact evaluation, where a yield gain is measured on an experimental plot or a farm trial and then applied to the area over which diffusion has occurred, is overly fraught with untenable assumptions about what really occurred, especially in evaluating impacts on incomes and poverty. Derived estimates of impacts may not resist scrutiny.

Fortunately, there exist a number of guiding principles to measure the impact of technology adoption on desirable outcomes that can be recognized (de Janvry, Dustan, and Sadoulet, 2010). The outcome variable can be expected restricted profits at the plot level, or broader measures of household income and consumption. The technology can also seek risk reduction, quality improvements, and positive environmental externalities. Measurement of these impacts is particularly difficult because adoption is an endogenous choice, with the implication that selection makes choice of counterfactuals against whom to compare adopters very tricky. In addition, diffusion transforms the impact, with gradual learning-by-doing among early adopters, differences in capacities and endowments between early and subsequent adopters, spillover effects across adopters and non-adopters, partial equilibrium effects with eventually falling prices and rising wages

on the corresponding markets, and general equilibrium effects on other sectors of the economy and on macro balances.

There are a number of current practices in the impact evaluation of agricultural technology that should be avoided. Here, we mention two.

(1) Use of experimental plots is adequate for agronomists in mapping out the production function, but choice of a point on that function to measure yield gain may not be adequate for economists when there are important interactions between the new technology and input use and resource allocation on and off the farm. Selection of a point on the new production function where the yield gain is measured has to be an endogenous choice that corresponds to the farmer's optimization behavior.

(2) Widely used propensity score matching methods, with selection on observables to identify a counterfactual, is not adequate because endogenous choice regarding adoption has been exercised by both adopters and non-adopters. As a consequence (like in microfinance), it is evident that adopters and non-adopters differ in fundamental non-observable characteristics that made them adopt or not. This easy approach that conveniently allows to use cross-sectional survey data is unfortunately not applicable for this particular problem.

Recommendations as to how to proceed in achieving more rigorous impact analysis of technology adoption are the following.

(1) Each case of technological change must be analyzed for its own idiosyncrasy and opportunities for identification. The research design should in as much as possible be defined before the study is undertaken in order to take advantage of identification opportunities, and to collect base line data in correspondence with the identification strategy.

(2) Randomized control trials may be used, but care must be given not to impose or induce use of the technological innovation among farmers who would not normally adopt. Treated producers must be would-be-adopters in a non-experimental set-up. For this, incentives to adopt should mimic market conditions and self-interested state or civil society behavior that will apply beyond the experiment, thus favoring scalability and sustainability of the results.

(3) Technology rollouts, where availability of the new technology is happening gradually across time and space, offer identification opportunities that apply well to agriculture. The unit of analysis would be the community to allow for local spillovers. Supply-side interventions can be through the controlled training and set-up of local agro-dealers, or through targeted interventions of the public extension service.

(4) Evaluation should be conducted in the process of technology rollout, in particular to collect information (in as much as possible administrative) on sites where the technology has not yet been rolled out, where it is being rolled out, and where it has already rolled out.

(5) Partial equilibrium and general equilibrium effects can constitute the largest long term benefits of a technology, and these benefits can occur in locations far removed from the farm. They can be estimated econometrically in small village economies as done by Foster and Rosenzweig (1996) using panel data to assess the impact of the Green Revolution in India. If we are concerned with assessing the impact of a forthcoming

Green Revolution in Africa, similar data collection should be put into place, and this has to be done now. Broader effects can also be simulated in economic surplus models and in computable general equilibrium models. While these models are not estimated, they can provide useful approximations of broader effects

Experimenting with improved impact assessments of agricultural technology is urgently needed. This is important both for accountability to donors, and to learn from impacts as they materialize. Case studies of specific technologies such as hybrid seeds, Quality Protein Maize, drought resistant varieties, and flood resistant rice should be initiated to learn how to use the improved methods.

8. How to proceed with implementation? Implications for strategies, discovery, and training

In the end, revisiting the state of world agriculture for development three years after the WDR 2008 shows the existence of tremendous opportunities, important new advances, and a hugely incomplete task in need of urgent progress. While resources have been committed, with delivery yet uncertain, much remains to be learned as to how to use agriculture for development, both conceptually and in practice.

A first recurrent theme that emerged through the “revisit” is recognition of the complexity of using agriculture for development because of the multidimensionality of the enterprise. While conditional cash transfers may appear difficult to use to reduce poverty, this pales in relation to the use of agriculture for development. In issue after issue revisited—from using agriculture to achieve a structural transformation of the economy, to implementing an integral approach to reduce rural poverty, managing food security as in Fome Zero, cracking open the adoption puzzle, and identifying new approaches to rural development such as participation of smallholder farmers to high value chains—, we uncovered the need for more comprehensive approaches to achieve success. These comprehensive approaches are needed to coordinate the essential roles of the state, the private sector, and civil society in taking agriculture for development to higher equilibriums. Countries need their own comprehensive visions, and multisectoral approaches are needed to achieve development. In addition, international agencies need major reforms to achieve better coordination, improved decision making, and greater efficiency at a global scale (Cleaver, 2010). This is in a sense a call to return to informed and participatory coordination, a new form of planning to draft medium-term strategy papers and coordinate actors in implementation.

A second recurrent theme is that we need to improve learning about how to better implement agriculture-for-development projects. We noted the existence of extraordinary new opportunities on a multiplicity of fronts, both technological and institutional. The examples of contracting in high value chains and using mobile phone technology were just two. Considerable efforts must be made to discover new approaches, pilot them in the field, evaluate impacts and their pathways, and learn from results to improve on designs. At the moment, development initiatives are too often seeking immediate impacts over learning, when the long run value of these initiatives will undoubtedly be in the

lessons derived from implementation and the subsequent improvement and adaptation of designs.

Finally, we repeatedly ran into the reality of large discrepancies between design and implementation. The latter requires capacities that have been badly depleted as agriculture was neglected over a long period of time where other priorities and misunderstanding of what agriculture could contribute to development prevailed. What we see is a return of interest in using agriculture for development that is not accompanied by a corresponding investment in capacity building at all levels, from local to global. Without the development of capacities, agriculture for development will not succeed in spite of extraordinary opportunities.

Three pragmatic recommendations derive from the revisit:

(1) Using agriculture for development, including to achieve food security, is complex because it is so multidimensional, requiring broad comprehensive strategies defined at the country level and periodically re-adjusted. These strategies require rigorous assessments of the state of agriculture for development, rigorous impact evaluations of successes and failures, and experimentation with new options. National agriculture for development strategy papers should be developed, based on sound data collection and analytics, and with extensive stakeholder participation. This would build on highly promising initiatives such as the CAADP compacts and their associated knowledge systems (Badiane, 2010).

(2) Implementation will require additional research done by economists in the region. In Sub-Saharan Africa, the AERC can have a key role to play. Dedicated research support could be provided to expand the AERC research agenda toward agriculture, food security, rural development, and natural resource management.

(3) Training in using agriculture for development is also needed, as the old cadre of experts in agriculture has aged and often become somewhat obsolete. Strong support should be given to training at the Master's level though the Collaborative Master of Science Program in Agricultural and Applied Economics (CMAAE) for East and Southern Africa and similar regional networks for other regions. Training in the practice of agriculture for development is necessary both in developing and in industrialized countries.

References

- Adelman, Irma. 1978. *Redistribution Before Growth—A Strategy for Developing Countries*. The Hague: Martinus Nijhof.
- Adelman, Irma. 1984. "Beyond Export-led Growth." *World Development* 12(9): 937-49.
- Aker, Jenny. 2010. "Dial 'A' for agriculture: Using information and communication technologies for agricultural extension in developing countries." UC Berkeley Conference on Agriculture for Development-Revisited.
- Anderson, Kym, and Will Martin. 2010. "Trade distortions and food price surges." UC Berkeley Conference on Agriculture for Development-Revisited.

- ATAI. 2010. "Barriers to the adoption of agricultural technologies in developing countries." J-PAL-CEGA ATAI Whitepaper.
- Badiane, Ousmane. 2010. "Agricultural and economic growth recovery in Africa: Current trends and future prospects." Washington D.C.: IFPRI.
- Brooks, Karen. 2010. "African agriculture—What do we not know? What do we need to know?" UC Berkeley Conference on Agriculture for Development-Revisited.
- Cleaver, Kevin. 2010. "The impact on developing country agriculture of the global economic downturn and the OECD fiscal crisis; and key reforms needed in international assistance to agriculture." UC Berkeley Conference on Agriculture for Development-Revisited.
- Deininger, Klaus, and Derek Byerlee. 2010. "The rise of large-scale farms in land-abundant developing countries: Does it have a future?" UC Berkeley Conference on Agriculture for Development-Revisited.
- de Janvry, Alain, Andrew Dustan, and Elisabeth Sadoulet. 2010. "Recent advances in impact analysis methods for ex-post impact assessments of agricultural technology: Options for the CGIAR." UC Berkeley Conference on Agriculture for Development-Revisited.
- Dethier, Jean-Jacques. 2010. "Agriculture for Development-Revisited: Introductory remarks". UC Berkeley Conference on Agriculture for Development-Revisited.
- Foster, Andrew, and Mark Rosenzweig. 2004. "Agricultural productivity growth, rural economic diversity, and economic reform: India, 1970-2000." *Economic Development and Cultural Change* 52(3): 509-42.
- Foster, Andrew, and Mark Rosenzweig. 2010a. "Microeconomics of Technology Adoption." Economic Growth Center Discussion Paper no. 984, Yale University, New Haven.
- Foster, Andrew, and Mark Rosenzweig. 2010b. "Barriers to farm profitability in India: Mechanization, scale, and credit markets." UC Berkeley Conference on Agriculture for Development-Revisited.
- Gollin, Douglas. 2010. "Agricultural Productivity, Economic Growth, and Food Security." UC Berkeley Conference on Agriculture for Development-Revisited.
- Harrison, Ann. 2010. "Agriculture for Development-Revisited: Introductory remarks". UC Berkeley Conference on Agriculture for Development-Revisited.
- Himanshu, Peter Lanjouw, Abhiroop Mukhopadhyay, and Rinku Murgai. 2010. "Non-farm diversification and rural poverty decline: A perspective from Indian sample survey and village study data." UC Berkeley Conference on Agriculture for Development-Revisited. UC Berkeley Conference on Agriculture for Development-Revisited.
- Lin, Justin Yifu. 2010a. "New Structural Economics: A Framework for Rethinking Development." Policy Research Working Paper 5197, The World Bank.
- Lin, Justin Yifu. 2010b. "Challenges of agriculture and rural development." UC Berkeley Conference on Agriculture for Development-Revisited.
- Mellor, John. 1976. *The New Economics of Growth: A Strategy for India and the Developing World*. Ithaca, N.Y.: Cornell University Press.
- Oxfam. 2010. *Halving Hunger: Still Possible? Building a rescue package to set the MDGs back on track*. www.oxfam.org

- Ravallion, Martin. 2010. "Agriculture for Poverty Reduction–Revisited." UC Berkeley Conference on Agriculture for Development-Revisited.
- Swinnen, Jo. 2010. "Governance and smallholder farmer competitiveness in high value food chains." (with Miet Maertens and Anneleen Vandeplas) UC Berkeley Conference on Agriculture for Development-Revisited.
- Traxler, Greg. 2010. "How to make agriculture for development into a reality: Perspective from a family foundation." UC Berkeley Conference on Agriculture for Development-Revisited.
- Udry, Christopher. 2010. "Adoption of intensified agricultural technology in Africa." UC Berkeley Conference on Agriculture for Development-Revisited.
- World Bank. 2007. *Agriculture for Development. World Development Report 2008*. Washington D.C.
- Wright, Brian. 2010. "Grain reserves and food security in MENA countries." UC Berkeley Conference on Agriculture for Development-Revisited.