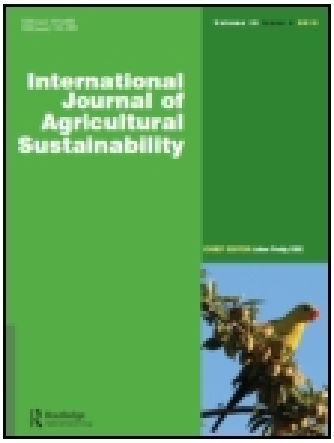

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Can organic and resource-conserving agriculture improve livelihoods? A synthesis

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Organic and resource-conserving agriculture (ORCA) initiatives have been common in the tropics for several decades, but surprisingly few data are available on their performance. This synthesis examined 31 documented cases of African and Latin American farmers converting from conventional or organic-by-default systems to ORCA that assessed their impact on livelihoods. Yield improved in 19 of the 25 cases that reported on it, food security improved in seven of eight cases, and net income improved in 19 of 23 cases. However, it is not possible to generalize from these results due to the small sample, selection bias and inconsistent methods and definitions across the cases. The systems from which farmers converted (conventional or organic-by-default) and the degree of market orientation strongly influenced the gain in incomes. Successful ORCA initiatives do not occur spontaneously, but rather require a variety of skills from smallholders and their allies. These skills include adaptive farm management, effective producer organizations, entrepreneurship, capacity to innovate, value addition and boundary spanning. The challenge of acquiring these enabling skills is simultaneously one of ORCA's strengths, as they help smallholders to navigate changing environmental and market conditions.

Keywords: Africa; farming systems; organic agriculture; resource-conserving agriculture; small farmers; sustainable livelihoods.

Introduction

Since the mid-1980s, the proportion of people in Africa living on a dollar a day has stubbornly stayed around 50% (Ravallion *et al*. 2007). During this time, Africa has had some success in increasing net agricultural productivity (Pretty *et al*. 2011). However, population growth has outstripped these increases with the result that food production per capita has declined (World Bank 2007). As population pressure increases and land holdings shrink, many poor smallholders have resorted to more frequent cropping, curtailing traditional long fallows and other ways of harnessing ecological processes to restore soil nutrients lost with repeated harvests (Henao and Baanante 2006, Cobo *et al*. 2010, Moebius-Clune *et al*. 2011).

Many researchers assert that sub-Saharan Africa's way out of poverty lies with the wider use of Green Revolution technologies (Evenson and Gollin 2000, Fischer *et al*. 2009). These technologies have contributed to steady yield improvements in other parts of the world, with cereal yields in East Asia and the Pacific nearly tripling (World Bank 2007). However, these conventional agriculture technologies are also associated with greenhouse gas emissions, pesticide residues, reduced biodiversity, soil erosion, declining fertility and

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salt build-ups (Lichtfouse *et al*. 2009, Flora 2010, Röling 2010, Gomiero *et al*. 2011). As the world's population tracks towards 9 billion by 2050, increased competition for fixed land and water resources will necessarily pose problems for generating continued productivity increases required to meet food needs. Finally, with energy supplies declining and greenhouse gas concentrations rising, conventional agricultures' use of increasing quantities of inorganic nitrogen presents a particular challenge (Galloway *et al*. 2008, Lin *et al*. 2011, Pimentel 2011).

Against this backdrop, some researchers suggest that organic and resource-conserving agriculture (ORCA) has sound potential for improving livelihoods of smallholders in Africa (Crucefix 1998, Sanchez 2002, Parrott and van Elzakker 2003, Hine and Pretty 2006). A recent report published under UN auspicies by authors from backgrounds both corporate and non-profit asserts that as we inevitably face increasingly constrained agricultural resources, eco-agricultural approaches will take on more urgent priority (Giovannucci *et al*. 2012). The ORCA umbrella covers resource-conserving, organic and traditional agriculture systems as defined below; however, ORCA does not include organic-by-default. The list below defines the terms for agricultural systems discussed in this paper. Figure 1 shows the relationships among them.

1. *Resource-conserving agriculture* makes the best use of natural goods and services without compromising their future use, and promotes social, environmental and health goals along with productivity gains. Practices include integrated pest and nutrient management, conservation tillage, agroforestry, aquaculture, water harvesting and livestock integration. These technologies facilitate soil replenishment using locally available organic fertilizers, cover crops, use of nitrogen-fixing legumes and other crop rotations, and mulches; improved water management; and crop diversification to reduce the risk of crop failure (Sullivan 2002, Kwesiga *et al*. 2003, Lotter 2003, Scialabba *et al*. undated). Resource-conserving agriculture does not exclude synthetic agrochemicals if they improve productivity without harming the environment (Pretty *et al*. 2006).

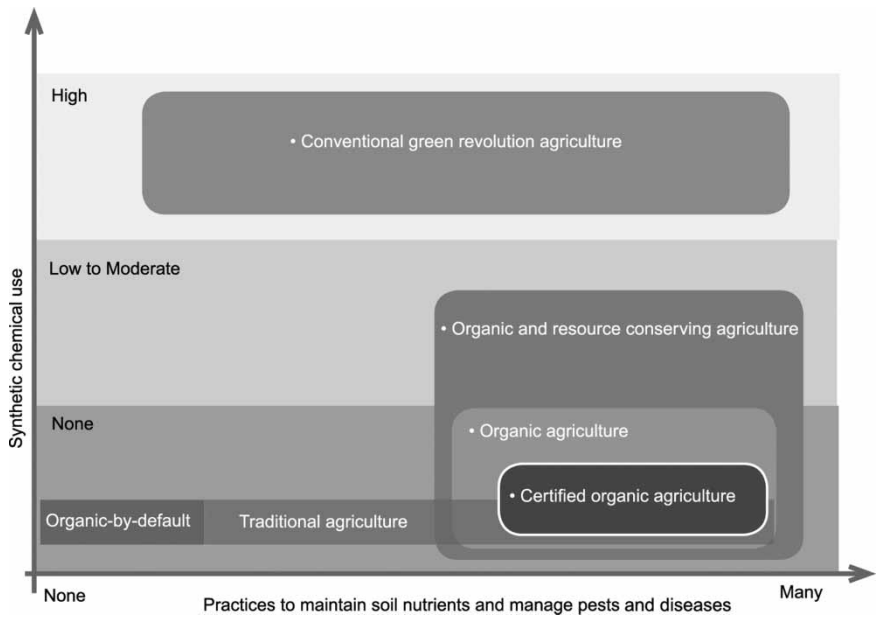

Figure 1. Various farming systems and the interrelationships of practices and synthetic chemical use.

2. *Organic agriculture* uses many of the same technologies as resource-conserving agriculture (Pretty *et al*. 2006) but prohibits all use of synthetic chemicals (IFOAM undated).
3. *Certified organic agriculture* is primarily a legal distinction in that certified products are verified to have been produced according to specified standards often codified in national law. Certification is largely a marketing strategy with agronomic implications. All certification standards adhere to general concepts of organic agriculture but differ in their specific requirements and prohibitions (Barrett *et al*. 2002, Kilcher *et al*. 2006).
4. *Traditional agriculture* encompasses systems that evolved before synthetic agrochemicals. Many, but not all, harness local ecological processes for enhancing productivity while conserving the natural resource base. Those traditional systems that explicitly manage and conserve natural resources fit under the ORCA umbrella. However, this form of agriculture is becoming increasingly rare. Population pressure has curtailed long fallows in particular, leading to an accelerating rate of widespread soil degradation (Walaga 2004, Giovannucci 2005).
5. *Organic-by-default* occurs where fertilizers are unavailable, or low real prices for farm products coupled with high prices for synthetic fertilizers have prevented farmers from using enough fertilizer to make up for lapsed traditional practices to maintain fertility (Heerink 2005). The resulting 'organic-by-default' practices of continuous cropping without attending to soil fertility has degraded African soils on a massive scale (Walaga 2004, Sanchez and Swaminathan 2005). The ORCA umbrella does not cover organic-by-default.

ORCA is often considered to involve high costs and low returns relative to conventional farming systems (van der Vossen 2005), but there are several reasons why ORCA could be attractive:

1. ORCA's emphasis on the prudent use of primarily local resources to increase yields suggests that it may be effective in areas where the Green Revolution has not brought improvements, especially areas where external inputs are not available or prohibitively expensive (de Jager *et al*. 2004). Farmers in such areas have a competitive advantage in certified organic agriculture because they do not have to wait through the 3-year transition period required of farmers who have used agrochemicals (Parrott and van Elzakker 2003, Setboonsarng 2006).
2. Agricultural and agroforestry researchers have developed a range of practices (such as hedgerow intercropping and improved fallows for soil fertility, barrier hedges and multistrata systems for controlling erosion, and fodder trees for nutrient cycling while yielding additional food or income sources) that stress making the most of natural resources and learning what makes them work for smallholders (Cooper *et al*. 1996).
3. Rising demand and high prices for certified organic products in developed countries could help farmers increase their incomes (Greene *et al*. 2009, Oberholtzer *et al*. 2012).
4. The need to meet various standards is becoming a pervasive and permanent feature of the smallholder domain (Reardon *et al*. 2005). Organic certification programmes help farmers build their capacity to meet standards and thus stay competitive in formal markets (Reardon *et al*. 2005, Asfaw 2007, Santacoloma 2007).

A strategy of prudently exploiting local inputs and ecological processes rather than using external inputs has particular relevance given long-term projections of rising prices for food and agricultural inputs driven by increasing competition for land, water and energy. Rising fossil fuel costs are particularly problematic since these are consistently linked to those of inorganic nitrogen (Piesse and Thirtle 2009, Beddington 2010). Long-term rises in costs of fertilizer can continue to keep it unaffordable for poor smallholders who now feed much of the world's poor and who will drive much of the world's future population growth (Herrero *et al*. 2010).

This paper assesses the potential of ORCA as a complement to Green Revolution systems in meeting agricultural challenges facing African smallholders. It synthesizes the results of available case studies of smallholders converting to ORCA including information on yields, product prices, food security and incomes. Because of the few studies available about Africa, this paper also reviews cases from developing countries in Latin America and Asia. We also look beyond the case studies to identify factors that improved or hindered the likelihood that smallholders adopting ORCA systems would sustainably improve their livelihoods.

Methods

We used Web of Science, Google Scholar and other search engines to find publications about ORCA adopted by smallholders in developing countries. The searches surfaced many publications related to these agricultural systems; however, only a few offered comparisons of ORCA and conventional systems in developing countries and fewer still contained sufficient detail to judge the reliability of the conclusions. We applied the following criteria to include case studies in this review: they be published or commissioned by a peer-reviewed journal or a United Nations or government-associated institute; cite sources for data; and provide at least some specific reporting on yield, food security, prices, revenue or income. We did not include studies on effects from implementing individual technologies such as specific agroforestry practices. Such technologies by themselves do not fit under the umbrella of ORCA principles and adequately covering the literature on these practices would be its own major initiative. We also excluded cases that appeared to be primarily advocacy pieces without any critical component.

We analysed the selected case studies in two ways. First, we aggregated case results and summarized impacts on food security, yield and incomes for smallholders. We then segmented the studies according to various dimensions including region, farming systems and market orientation to look for patterns of success or failure. These analyses showed that studies of Asian ORCA initiatives did not consistently report on the same set of economic indicators (production, income and food security), but they did report on factors affecting implementation (e.g. high rate of projects initiated from outside communities; need for farmer groups with significant organizational and management capacities; required investment in human capital) (Tripp 2006, Santacoloma 2007). Therefore, we compared only African and Latin American initiatives on production, income and food security, but included the Asian cases in investigating factors affecting implementation. Finally, we extended the review beyond the case studies to other literature to investigate factors contributing to the likelihood that smallholders adopting ORCA systems could sustainably improve their livelihoods.

As many researchers point out, the literature on ORCA is sparse (Tripp 2006, Gibbon and Bolwig 2007, Blackman and Rivera 2010). Only 31 studies met our criteria for inclusion in our analysis (see the Appendix). Even these studies did not always use consistent methodologies or maintain high statistical rigour. Also, practicality led many researchers to select cases from active initiatives, which created a bias towards success. Therefore, the conclusions from this review are not generalizable. Rather, they provide guideposts for future research that can further hone in on specific strategies that will improve smallholder livelihoods and the conditions under which these strategies may be most fruitful.

Analytical framework

Site-specific drivers of ORCA impacts

Our review of the cases indicated that ORCA's impact is strongly influenced by two factors: the type of farming system preceding conversion to ORCA ('original farming system') and the degree

of market integration. The 'original farming system' may be anything ranging from organic-by-default systems using few or no inputs to manage soil fertility, pests and diseases to conventional farmers using appreciable amounts of purchased synthetic inputs.

Degrees of market integration range from subsistence scenarios, in which farmers hardly participate in markets; through transitional scenarios, in which farmers sell some produce, generally in informal local markets; to cash-cropping scenarios, in which farmers sell nearly their entire crop, generally through formal markets, and purchase food with the income they obtain. Neither ORCA nor conventional farming systems inherently exclude any of the market scenarios and vice versa, although low market integration implies that little cash is available for purchasing synthetic inputs (Bennett and Franzel 2009). As Table 1 shows, differing levels of market integration offer differing potential for increased incomes, and different farming systems tend to be associated with specific market integration scenarios.

We expected that livelihood benefits to farmers from conversion to ORCA would be driven by these twin factors of original farming system and degree of market integration. As Figure 2 shows, ORCA can provide benefits in three different ways: by increasing productivity, by reducing costs and by increasing product prices. The first two ways are largely driven by the type of farming system from which farmers convert. Organic-by-default farmers adopting ORCA practices have the potential to increase productivity whereas conventional farmers' likely impact is to reduce costs by substituting labour and other locally available inputs for purchased ones. The third way to obtain benefits from ORCA, by increasing product prices, is available as a marketing strategy to farmers with a high degree of market integration. When cash croppers acquire *certified* organic status and target richer markets in North America, Europe and Japan, they can earn higher incomes from the price premiums that certification commands. North America and Europe account for 96% of all certified organic revenues (Sahota 2006). A certification strategy requires a high degree of market integration so that the infrastructure and networks needed to export produce are present locally.

We categorized outcomes from the case studies as follows.

If a study provided evidence about:

- Farmers' experience of hunger, we regarded it as evidence on food security impacts.
- Increases or decreases in yield or about farmers having more or less produce to sell, we regarded it as evidence of yield impacts.

Table 1. Market integration, income potential and participation requirements.

Factors	Subsistence farmers	Transitional farmers	Cash-crop farmers
Degree of market integration	Low	Participate in informal local markets only	Participate in formal domestic and export markets
Potential for increasing income from market integration	Low	Medium	High
Threshold requirements for participation	None	Emerging constraints in meeting requirements of quality, safety, consistency of product and regular supply	Must be well organized and able to guarantee safety, uniform quality, consistency of product and regular supply

Source: Adapted from Narrod *et al*. (2007).

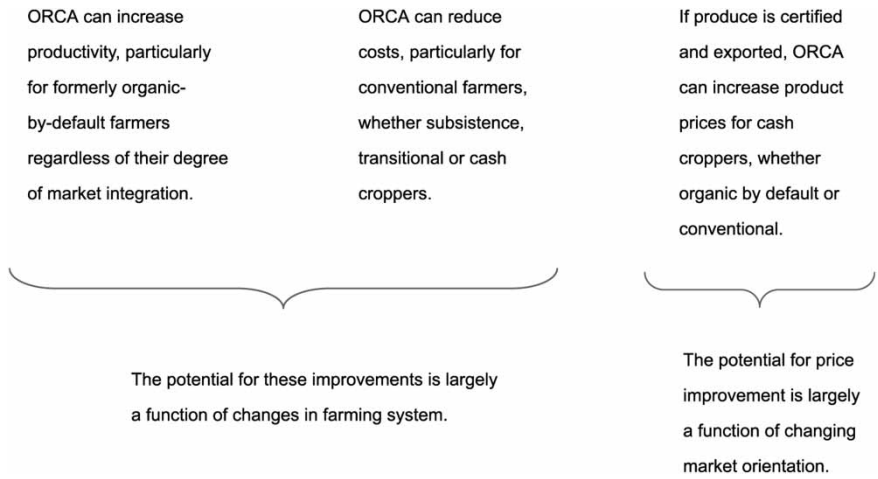

Figure 2. Ways in which ORCA can improve livelihoods.

- Increases or decreases in income, we regarded it as evidence of net income impacts.
- Increases or decreases in price, we regarded it as evidence of price impacts.
- Increases or decreases in revenue, we regarded it as evidence of revenue impacts.

Many studies did not sufficiently describe their methods for measuring outcomes. Where they did, it was clear methods differed. For example, in some case studies the counterfactual was farmers before converting to ORCA (before–after approach), in others it was farmers not converting to ORCA (with–without approach) while other cases did not clearly specify the counterfactual. Some studies relied on farmers' perceptions about outcomes while others used more formal techniques to measure the outcomes themselves. Aggregating across cases in such circumstances is not ideal, but the alternative would be to altogether abandon the effort to gain from the limited work that has been done on ORCA impacts.

Framework for evaluating ORCA's capacity to improve livelihoods and sustain the improvements

In analysing the likelihood that farmers practicing ORCA may achieve sustainable livelihood improvements, we assessed ORCA according to the Sustainable Livelihood Framework adopted by the United Kingdom's Department for International Development. According to the framework, a livelihood is made up of the capabilities, material and social assets, and activities needed to earn a living. The framework recognizes that interventions must take place within the context of livelihood systems, rather than addressing only a single sector or component of the systems (DFID 1999).

The term 'sustainable' in the framework indicates the ability of livelihood earners to cope with sudden shocks and long-term trends, and to enhance their capabilities without undermining their natural resource base. To maintain this ability, individuals and their communities must possess assets in five capital types:

1. *Natural* resources giving rise to flows and services such as nutrient cycling and erosion protection.
2. *Social* resources developed through informal or formal networks and groups, trust relationships and modes of reciprocity and exchange.

3. *Human* resources of skills, knowledge, good health and ability to work together enabling people to pursue livelihoods.
4. *Physical* resources including infrastructure, tools and equipment such as transport links, shelter, adequate water supply and sanitation, energy and communications.
5. *Financial* resources including savings and incomes.

Results

Livelihood effects of ORCA initiatives

We found 11 studies reporting on 31 ORCA conversion initiatives: 14 in Africa and 17 in Latin America. In African initiatives, farmers grew cocoa, coffee, cotton, fruit, herbs, maize, pineapple, vanilla and vegetables. In Latin American initiatives, farmers produced bananas, cocoa, coffee, fruit, honey, sugar and vegetables. Twenty-eight cases reported on initiatives of small farmers with farm sizes (or areas under cash-crops where farm sizes were not reported) ranging from 0.87 to 7 ha. In two additional cases farm sizes ranged from 8 to 40 ha. We also included one case that reported on conversion to ORCA by a coffee estate. We found very few studies of conversion to ORCA by farms of any size in developing countries and this latter case provided more methodological details than many cases we found.

Table 2 summarizes these studies and shows that ORCA often outperformed conventional and organic-by-default agriculture with respect to yield, net income and food security. Yield improved upon conversion to ORCA in 16 of the 25 cases that reported on it, food security improved in seven of eight such cases and net income improved in 19 of 23 such cases.

Converting to ORCA from organic-by-default systems proved more positive for crop yields than did converting from conventional systems (Figure 3). In 19 conversions from organic-by-default in which yields were documented, they increased in 12 and decreased in only one. In three conversions, the new practices allowed farmers to grow additional types of crops, and in the remaining three conversions yields stayed the same. The increases from conversions to ORCA not only allowed farmers to fulfil previously unmet food needs, but they sometimes produced surpluses that subsistence farmers sold in local markets. On the other hand, converting from conventional systems to ORCA usually reduced yields. In the six conversions from conventional systems that reported yields, they increased in only one and decreased in five.

ORCA initiatives generated increases in net incomes in a majority of cases, and the analysis indicates distinct patterns associated with farming systems (Figure 4) and market integration (Figure 5). Conversions from organic-by-default fared notably better than those from conventional, with net incomes increasing in 12 of the 13 organic-by-default cases in which incomes

Table 2. ORCA initiative impacts on yield, price premiums, net income and food security reported in Africa and Latin America.

			Of cases with data, those reporting...	
Factor	Total cases	Cases reporting impact on factor	Improvements from ORCA over non-ORCA	The same or worse results from ORCA compared with non-ORCA
Yield	31	25	16 (64%)	9 (36%)
Food security	31	8	7 (88%)	1 (13%)
Net income	31	23	19 (83%)	4 (17%)
Price premiums	31	19	14 (74%)	5 (26%)

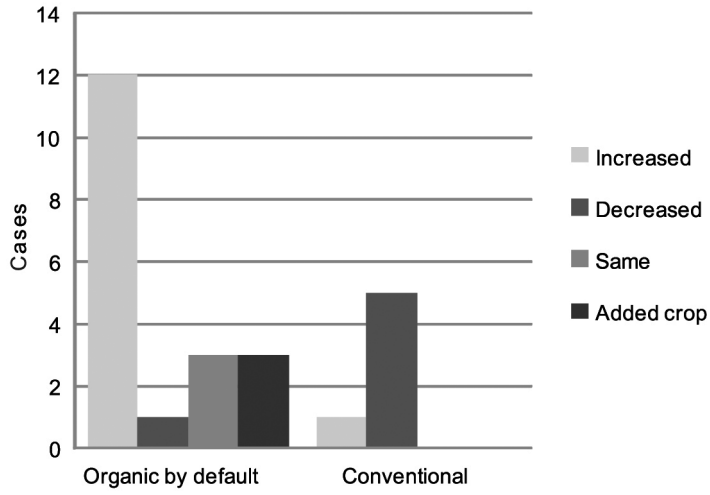

Figure 3. Yield impacts of ORCA conversion by original farming system.

were reported. Conversion from organic-by-default often brings both higher yields and higher prices. Conversion to ORCA appeared more problematic for the conventional farmers. Among five conversions from conventional systems reporting net income, only three reported increases, while net income either decreased or did not increase for two. This is consistent with a report by Gibbon and Bolwig (2007) that conventional farms in developed settings often initially see decreases in net income due to yield collapses upon eliminating pesticides and mineral fertilizers. Of the two cases in our analysis with net income decline or no increase, one was for a large farm. It is unknown whether farm size may have influenced this result. This case also reported that yields declined upon conversion to ORCA and that the farm did not obtain any price premium.

For net income changes associated with market integration, increases occurred in all five low-integration cases that reported on incomes. Of the 16 high-integration cases reporting on incomes, 75% realized increases as compared with non-ORCA. Interestingly, 16 of 20 high-integration cases reported on income changes while only five of 10 low-integration cases did so. This result possibly reflects that projects working with highly integrated farms target net income more often than projects with less-integrated farms.

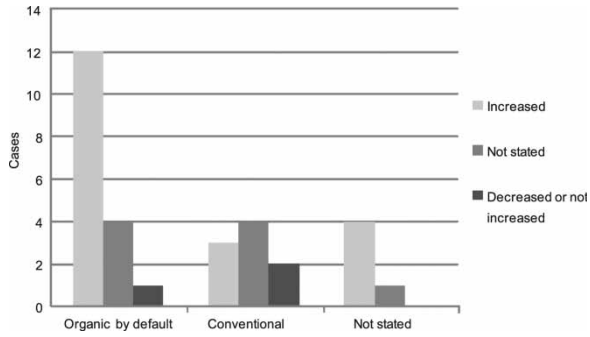

Figure 4. Net income impacts of ORCA conversion by original farming system.

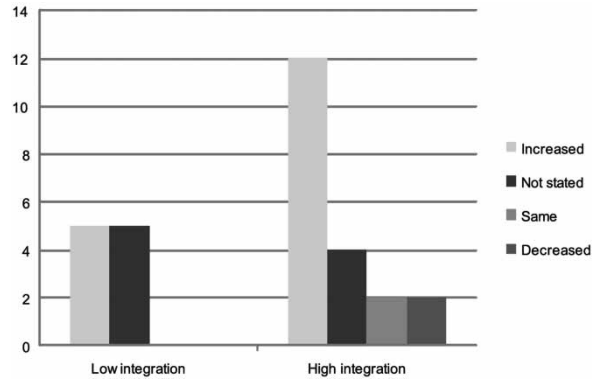

Figure 5. Market integration and net income improvement following ORCA conversion.

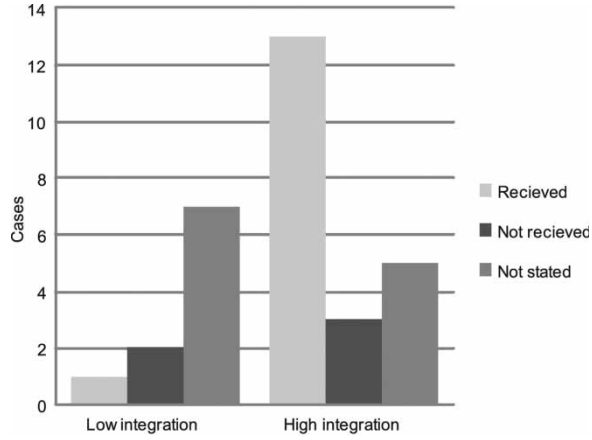

Figure 6. Price premiums received by high and low market integration.

Price premiums drove the net income increases given that farmers received price premiums from 4 to 150% in the 14 of 19 cases that reported them. In all 19 cases reporting price premiums, farmers had obtained organic certification and in all but one case they exported their products. Price premiums and certification were more common for cases with high market integration than for cases with low integration (Figure 6) because certification generally makes sense only if farmers can access export markets. In areas of low market integration, certification is generally not an option as the infrastructure for exporting is often poor.

Effects on costs

ORCA cases show mixed impacts on costs, suggesting that cost impacts are specific to sites and crops and that impacts may not always be predictable although initial farming systems can give some indication of the expected direction of changes. In general, conventional farmers see total variable costs decline upon conversion to ORCA because lower costs for material inputs more than offset higher labour costs. Still, one study reported cases in Latin America in which total costs rose for conventional farmers who adopted certified organic practices (van der Vossen 2005). Studies showed that, for organic-by-default farmers converting to ORCA material costs

generally remained unchanged, but labour requirements increased. However, even with increases, farmers sometimes found returns on labour to be high. Increased labour use and high labour productivity produce a win–win situation for marginal farming areas because under-used labour resources became more productive. However, Meertens (1999) cautioned that in some cases, high dependence on labour-intensive techniques decreases labour productivity and impoverishes farm households.

Recent structural changes causing what appears to be a permanent increase in the cost of fertilizers – by 200% for nitrogen fertilizers in 2007 (IFDC 2008) – suggest that future conversions from conventional to ORCA practices could more consistently generate cost savings. Also, higher prices for fertilizers may constrain the role of conventional agriculture in helping poor, organic-by-default farmers in remote areas escape poverty.

The results of the ORCA initiatives studied suggest that ORCA offers farmers a way to protect the future productive capacity of their natural resource base *and* to also improve their livelihoods. Further, Figure 7 demonstrates how looking at results according to farmers' original farming systems and market orientation gives an indication of scenarios where adopting ORCA may have the most promise for improving livelihoods.

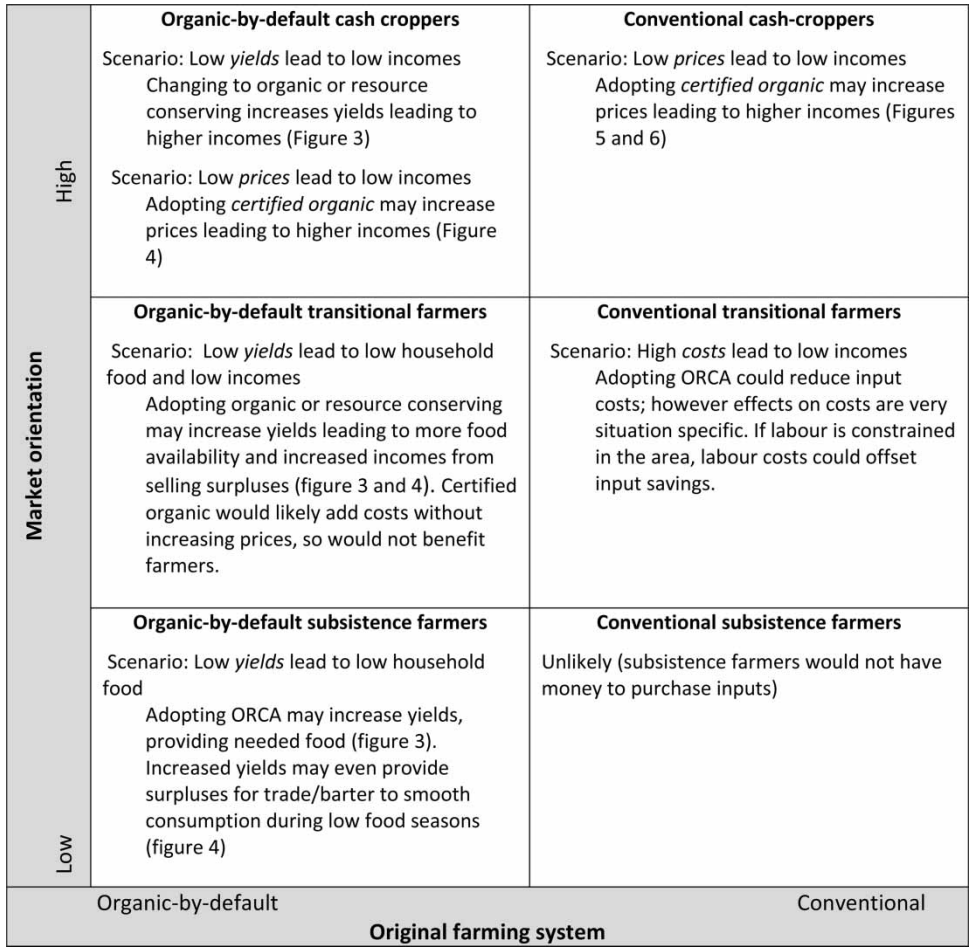

Figure 7. ORCA scenarios, choices and results suggested by analysis framework and case studies.

The flavours of African, Asian and Latin American ORCA

Documented ORCA initiatives in Africa showed distinct contrasts from those in other regions (Table 3). African initiatives were more oriented towards farmers with no or low market integration with 62% of initiatives involving subsistence farming or integration only within local markets, compared to only 18% of Latin American initiatives. The lack of commercial orientation for African initiatives suggests that livelihood issues more often revolved around basic needs, such as food security. And, the fact that 50% of African initiatives reported on food security impacts, compared with only 6% of Latin American initiatives, bespeaks of the saliency of food security for the farmers involved. In contrast, the Latin American initiatives showed a strong commercial orientation, with 82% involving cash-crops for export, compared to only 39% of African initiatives. As would be expected given that certification is valuable only to farmers integrated into export markets, all Latin American initiatives incorporated certification, but only 50% of African projects did. Whether the differences between African and Latin American initiatives reflect the desires of the farmers or the perspectives of those facilitating the initiatives (e.g. governments, non-governmental organizations (NGOs), companies) is unknown.

A common misperception about ORCA practices is that they will diffuse of their own accord (Tripp 2006). In fact, they are rarely adopted spontaneously but rather at the instigation of initiator-coordinators. Initiator-coordinators help farmers to establish structures and systems for successfully producing, monitoring and marketing certified produce. They must teach managerial and technical skills and assist producer organizations in setting up cost-effective internal control systems to ensure that produce meets organic certification standards (Santacoloma 2007). African initiatives differed noticeably from those in other areas in the types of organizations that facilitated them (Table 4). The striking finding for Africa was the complete absence of producer organizations as initiator-coordinators in all 14 ORCA efforts reported. This compares with 85% of 16 efforts in Latin America initiated by producer organizations and 35% of 17 efforts in Asia. NGOs were the main initiator-coordinators in Africa and private companies were the main ones in Asia. Governments acted as initiator-coordinators in only 9% of African efforts, compared with 46% in Latin America and 29% in Asia.

The patterns are similar for entities managing extension services. In Africa, companies and NGOs most frequently assumed this role, whereas in Latin America, producer organizations most often did. In Asia, governments and NGOs were most prominent. Virtually all the reviewed case studies had a specific marketer-exporter participating in the project. In projects promoted by Export Promotion of Organic Products from Africa, identifying an exporter was an indispensable first step towards establishing a project (Forss and Lundstrom 2004, Taylor 2006). Africa stands out in having private companies serving as marketer-exporters in 78% of initiatives, compared with 31% in Latin America and 56% in Asia (Table 4). Producer organizations and governments were noticeably absent as marketer-exporters in Africa, with no involvement from either in any project.

The relatively heavy involvement of private companies in African ORCA initiatives has both upsides and down. On the positive side, companies can furnish financial and knowledge resources beyond the capability of thinly stretched governments and NGOs. Development efforts that include private companies have done well at generating innovation. Studies in both Asia and Africa have found that smallholder farmers can benefit from participating in contract farming, an arrangement in which farmers supply produce to companies on contract (Setboonsarng *et al.* 2006, Gibbon and Bolwig 2007).

On the other hand, inherent conflicts of interest between farmers and companies can make farmers vulnerable in such arrangements. Case studies in China indicate that initiatives with only private companies and no producer organizations saw little of the price premiums from

Table 3. The effects of converting to ORCA practices in Africa and Latin America.

		Africa		Latin America	
		Number	Per cent	Number	Per cent
Total cases		14	100	17	100
Management before project					
	Traditional/organic-by-default	11	91	6	38
	Conventional	1	8	8	50
	Not farmed	0	0	2	13
	Not stated	2		1	
Yield					
	Decrease	2	17	4	31
	Increase	9	75	4	31
	Same	1	8	2	15
	Added crop	0	0	3	23
	Not stated	2		4	
Price premium received?					
	No	2	67	3	19
	Yes	1	33	13	81
	Not stated	11		1	
Net income effect					
	Not increased	1	11	1	7
	Increased	8	89	11	79
	Decreased	0	0	2	14
	Not stated	5		3	
Food security improved?					
	Improved due to production	6	86	1	100
	Improved due to income	0	0	0	0
	Not improved	1	14	0	0
	Not stated	7		16	
Primary market					
	Subsistence	2	15	0	0
	Local/domestic	5	39	3	18
	Domestic/export	1	8	0	0
	Export	5	39	14	82
	Not stated	1		0	
Certification type					
	Third party	6	46	15	88
	Participatory	0	0	2	12
	None	7	54	0	0
	Not stated	1		0	

organic certification returned to farmers. Instead, exporters and in some cases government organizations claimed the largest portion of the premiums (Giovannucci 2005). In Latin America, farmer cooperatives have proved key to smallholders' commanding better prices (Bacon 2005). Where NGOs are also involved, they can be a force for obtaining favourable terms for farmers. However, for long-term sustainability, projects should not rely on the continued presence of NGOs (Forss and Lundstrom 2004, Giovannucci 2005).

Discussion

These results give evidence that ORCA initiatives in certain cases produced livelihood improvements for poor smallholders. Due to the limitations of the case studies, generalizations cannot be

Table 4. Types of organizations and their functions in ORCA projects by region.

Region	No. of cases	Role (%)[a]											
		Initiator-coordinator				Extension provider				Marketer-exporter			
		Producer organization	Company	NGO	Government	Producer organization	Company	NGO	Government	Producer organization	Company	NGO	Government
Africa	14	0	50	90	9	0	71	71	14	0	78	44	0
Latin America	16	85	23	46	46	56	22	22	0	62	31	8	15
Asia	17	35	41	35	29	0	27	40	47	19	56	25	13
Total	48	41	37	54	29	16	34	41	25	28	51	23	10

[a]Percentages were calculated using as a denominator only the projects that stated the entity for the relevant role. Percentages sum to more than 100 because more than one entity often perform specific functions in a project.

made about the degree of net benefits ORCA can provide, but the results do attest to potential worth of pursuing more rigorous research.

ORCA's guiding principles often lead to integrated interventions that explicitly build assets in the previously mentioned five livelihood capitals needed for sustainable pathways out of poverty (DFID 1999). These assets strengthen farmers' abilities to respond to changing farm and market conditions (de Janvry and Sadoulet 2005). Sustaining gains from changes in farming systems requires the knowledge and agronomic capital to understand ecological processes and to use this understanding to experiment with new practices in response (de Jager *et al*. 2004). It also requires that smallholders and their allies have the capacity to integrate local knowledge with scientific knowledge (Hagmann and Chuma 2002, Mog 2006). The capacity to respond to changing natural/agronomic conditions will take on increasing importance with climate change.

Sustaining ORCA livelihood improvements from changes in marketing orientation requires the ability to track changing demand of retail buyers and of supply chain intermediaries in the organic and the larger retail food sectors. Livelihood gains from certified organic price premiums and increased access to markets could be unstable as large food retailers increase their market shares. Many have started to feature certified organic products in their stores. This trend could stimulate demand and thus maintain price premiums. However, in areas where large intermediaries dominate purchasing, they have a record of consolidating suppliers over time to reduce costs. This can exclude smallholders who do not adapt to new requirements (Reardon *et al*. 2005).

Expanding smallholders' capacity to understand and meet buyers' needs can improve farmers' ability to succeed not only in certified organic markets but also in dealing with changing market environments generally (Garibay 2006, Narrod *et al*. 2007). Certified organic initiatives, in particular, frequently start with a marketing orientation that requires farmers to build assets for understanding and efficiently meeting buyers' needs in formal markets (Forss and Lundstrom 2004). Research indicates that even as large firms take over greater shares of the retail food market, smallholders can sell to them if they can meet requirements that supplies be consistently available and of high quality (Best *et al*. 2005, Reardon *et al*. 2005, Davis 2006).

The emphasis in ORCA principles on farmer capacity to acquire knowledge and devise their own solutions to changing conditions is a key component of sustainable livelihood improvement. While conventional agricultural initiatives can and sometimes do take holistic approaches, this orientation is not inherent to conventional agriculture as it is to ORCA.

ORCA studies point to enablers that by directly building social and human assets can then help small holders amass capabilities in other capitals needed for sustainable livelihood gains:

1. *Adaptive farm management* – Experimentation, learning and understanding ecological processes are key attributes of adaptive farm management (Hagmann and Chuma 2002, Mog 2006). They support the ability to maintain the balance between productivity and conservation in dynamic conditions (Shennan 2008, Walcott and Wolfe 2008). Adaptive farm management is a human capital that can help farmers make the most of natural capital.
2. *Producer organizations* – These can help smallholders share knowledge, access external resources, reduce transaction costs, enhance product quality, market collectively, organize experimentation, and acquire and manage processing equipment for adding value and meeting market standards (Bacon 2005, Poulton *et al*. 2006, World Bank 2007). An important role for producer organizations is establishing the internal control systems needed to meet the standards markets demand and to reduce costs of smallholders supplying in bulk (Santacoloma 2007).
3. *Business strategy development and entrepreneurship* – Smallholders need an understanding of the economic and commercial factors that affect their position in supply chains (Bingen *et al*. 2003). They also need entrepreneurship skills to become active participants in marketing

Reardon and Berdegué 2006). These human skills can help ensure other improvement; for example, increased productivity will translate to increased financial capital.

4. *Strengthening knowledge processes and capacity to innovate* – To stay competitive as market outlets consolidate, smallholders must cultivate the capacity to innovate (Harris 2001, Davenport 2005, Nonaka 2005). This means smallholder communities need explicit processes to acquire, disseminate and maintain knowledge as well as keep alive access to external knowledge sources (OECD 1999, Spielman *et al*. 2008).
5. *Boundary spanning* – Smallholders must acquire and coordinate a variety of resources and institutional innovations for ORCA to sustainably improve their livelihoods. These resources and innovations include such diverse elements as obtaining and using agronomic information, collective marketing to reduce transaction costs and creating ways to influence government policies. Boundary-spanners must bring together resources and institutions, ensure smallholders have access to them and engage suppliers of skills who are not normally part of agricultural development projects (Kristjanson *et al*. 2009).

These enablers build capacity and supply knowledge critical to farmers for improving their livelihoods, whether or not certified production or other ORCA practices are viable options for them. Further, they can help farmers already integrated into formal markets retain competitiveness in the face of food retailer consolidation.

Conclusions and research priorities

The cases and other literature synthesized in this paper provide evidence of ORCA potential that is tantalizing for two reasons.

1. The cases show that ORCA has improved livelihoods for smallholders in developing countries while minimizing the use of external resources that could become increasingly unaffordable as world's rapidly growing population increases its demand for scarce resources needed for conventional agriculture, particularly water and energy.
2. ORCA initiatives, which inherently focus on building farmer knowledge, often offer enablers for building assets in the five sustainable livelihood capitals. By emphasizing adaptive capacity, ORCA interventions can empower farmers to experiment with the best production and marketing strategies for their circumstances – even if an intervention introduces specific practices not suitable to all participants; circumstances.

Although the lack of rigorous, consistent research methods for the cases make the results non-generalizable, the evidence of ORCA's capacity to deal with multiple agricultural and livelihood challenges merits it a rightful seat at the agricultural research 'table'. Research should explore whether and under what circumstances ORCA practices can improve livelihoods compared to other farming systems. Such studies should define methods using consistent approaches for measuring yields, food security and incomes. The Committee on Sustainability Assessment is implementing such an approach establishing a global database with defined indicators and data collection instruments for cocoa and coffee, but results are not yet available (Giovannucci *et al*. 2008). More global efforts along these lines are needed.

Information is also needed about the trade-offs involved, particularly considering the high levels of facilitation required in most ORCA initiatives. Moreover, such studies need to specifically consider the long-term benefits when projects build human capital. While it can be costly to build the smallholder skills ORCA requires (Santacoloma 2007), once acquired they can translate

into significant payoffs if they equip smallholders to stay in or access lucrative formal domestic and international markets (Bennett and Franzel 2009).

Specific research priorities are:

1. *Assessing costs, benefits and impacts on livelihoods* – especially assessing ORCA's profitability using uniform methods that allow cross-site comparisons. It is important to compare the returns from helping farmers invest in conventional agriculture with those from helping them invest in ORCA. Factors influencing success of ORCA and impacts on the poor and women also need to be studied.
2. *Building natural capital* – especially how to improve productivity in ORCA initiatives with particular focus on soils and pests.
3. *Building social and human assets* – especially identifying ways for farmers to build strong organizations and to embed systems of knowledge acquisition and dissemination into their communities.
4. *Optimizing partnerships and maintaining competitiveness* – especially identifying effective organizational structures for partnerships between producer organizations and private companies and how to achieve these.

Such a research could be a very good investment for many of the hundreds of millions of smallholders that currently produce the food for almost 1 billion of the world's poor.

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References

Asfaw, S., 2007. Does EurepGAP standard marginalize poor farmers? – evidence from Kenya. *Agriculture and rural development*, 14 (2), 45–47.

Bacon, C., 2005. Confronting the coffee crisis: can fair trade, organic, and specialty coffees reduce small-scale farmer vulnerability in northern Nicaragua? *World development*, 33 (3), 497–511.

Barrett, H., *et al.*, 2002. Organic certification and the UK market: organic imports from developing countries. *Food policy*, 27 (4), 301–318.

Beddington, J., 2010. Food security: contributions from science to a new and greener revolution. *Philosophical transactions of Royal Society B 12*, 365 (1537), 61–71.

Bennett, M. and Franzel, S., 2009. *Can organic and resource-conserving agriculture improve livelihoods? A meta-analysis and conceptual framework for site-specific evaluation*. ICRAF occasional paper no. 11. Nairobi: World Agroforestry Centre.

Best, R., *et al.*, 2005. Harnessing the power of partnerships in the marketplace: using a learning alliance for agroenterprise integration into agricultural recovery. *In*: J. Dixon, C. Neely, C. Lightfoot, M. Avila, D. Baker, C. Holding and C. King, eds. *Farming systems and poverty: Making a difference*, *Proceedings of a conference held in Rome, Italy, 31 October–3 November 2005. The 18th International Symposium of the International Farming Systems Association: A Global Learning Opportunity*, International Farming Systems Association: Rome, 21–30.

Bingen, J., Serrano, A., and Howard, J., 2003. Linking farmers to markets: different approaches to human capital development. *Food policy*, 28 (4), 405–419.

Blackman, A. and Rivera, J., 2010. *The evidence base for environmental and socioeconomic impacts of 'sustainable' certification*. Environment for Development Discussion Paper Series, EfD DP 10-10. Turrialba, Costa Rica and Washington, DC.

Bray, D.B., Sanchez, J.L.P., and Murphy, E.C., 2002. Social dimensions of organic coffee production in Mexico: lessons for eco-labeling initiatives. *Society and natural resources*, 15 (5), 429–446.

Caceres, D., 2005. Non-certified organic agriculture: an opportunity for resource-poor farmers? *Outlook for agriculture*, 23 (3), 135–140.

Cobo, J., Dercon, G., and Cadisch, G., 2010. Nutrient balances in African land use systems across different spatial scales: a review of approaches, challenges and progress. *Agriculture, ecosystems and environment*, 136 (1), 1–15.

Cooper, P.J.M., *et al.*, 1996. Agroforestry and the mitigation of land degradatin in the humid and sub-humid tropics of Africa. *Experimental agriculture*, 32 (3), 235–290.

Crucefix, D., 1998. *Organic agriculture and sustainable rural livelihoods in developing countries*. Bristol: Soil Association.

Damiani, O., 2001. *Organic agriculture in Costa Rica: the case of cacao and banana production in Talamanca* [online]. Rome: Office of Evaluation and Studies of the International Fund for Agricultural Development. Available from: http://www.grupochorlavi.org/organicos/doc1.pdf [Accessed 17 January 2008].

Davenport, T.H., 2005. *Thinking for a living: how to get better performances and results from knowledge workers*. Boston: Harvard Business School Press.

Davis, J.R., 2006. *How can the poor benefit from the growing markets for high value agricultural products?* [online]. Kent, UK: Natural Resources Institute. Available from: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=944027PaperDownload [Accessed 7 January 2008].

de Jager, A., Onduru, D., and Walaga, C., 2004. Facilitated learning in soil fertility management: assessing potentials of low-external-input technologies in east African farming systems. *Agricultural systems*, 79 (2), 205–223.

de Janvry, A. and Sadoulet, E., 2005. Achieving success in rural development: towards implementation of an integral approach. *Agricultural economics*, 32 (1), 75–89.

Department for International Development [DFID], 1999. *Sustainable livelihoods guidance sheets: introduction* [online]. Department for International Development. Available from: http://www.livelihoods.org/info/guidance_sheets_pdfs/section1.pdf [Accessed 13 September 2008].

Evenson, R. and Gollin, D., 2000. Assessing the impact of the Green Revolution, 1960 to 2000. *Science*, 300 (5620), 758–762.

Fischer, R., Byerlee, D., and Edmeades, G.O., 2009. *Can technology deliver on the yield challenge to 2050.* Expert meeting on how to feed the world in 2050. Rome: FAO, Economic and Social Development Department, 46 pp.

Flora, C.B., 2010. Food security in the context of energy resource depletion: Sustainable agriculture in developing countries. *Renewable agriculture and food systems*, 25 (2), 118–128.

Forss, K. and Lundstrom, M., 2004. *An evaluation of the program Expert Promotion of Organic Products from Africa, phase II*. Stockholm: Swedish International Development Co-operation Agency (Sida).

Galloway, J.N., *et al.*, 2008. Transformation of the nitrogen cycle: recent trends, questions and potential solutions. *Science*, 320 (5878), 889–892.

Garibay, S., 2006. *The European market for tropical organic products*. Research Institute of Organic Agriculture (FiBL). Slide presentation made at a conference held in Nuremberg, Germany, 16–19 February 2006. BioFach Congress. Bonn: International Federation of Organic Agriculture Movements (IFOAM). Available from: http://orgprints.org/7324/ [Accessed 21 October 2009].

Gibbon, P. and Bolwig, S., 2007. *The economics of certified organic farming in tropical Africa: A preliminary assessment*. DIIS working paper no. 2007/3, sub-series on standards and agro-food exports (SAFE) no. 7. Copenhagen: Danish Institute for International Studies.

Giovannucci, D., 2005. *Organic agriculture and poverty reduction in Asia*. Rome: Office of Evaluation, International Fund for Agricultural Development.

Giovannucci, D., *et al*. 2008. *Seeking sustainability: COSA preliminary analysis of sustainability initiatives in the coffee sector.* Committee on Sustainability Assessment: Winnipeg, Canada.

Giovannucci, D., *et al.*, 2012. *Food and agriculture: the future of sustainability. A strategic input to the sustainable development in the 21st century (SD21) project* [online]. New York: United Nations Division for Sustainable Development. Available from: http://www.un.org/esa/dsd/dsd_sd21st/21_pdf/agriculture_and_food_the_future_of_sustainability_web.pdf [Accessed 30 June 2012].

Gomiero, T., Pimentel, D., and Paoletti, M.G., 2011. Is there a need for a more sustainable agriculture? *Critical reviews in plant sciences*, 30 (1–2), 6–23.

Greene, C., *et al*., 2009. *Emerging issues in the U.S. organic industry* [online]. Economic Information Bulletin No. EIB-55. Washington, DC: USDA Economic Research Service. Available from: http://www.ers.usda.gov/publications/eib-economic-information-bulletin/eib55.aspx [Accessed 27 June 2012].

Hagmann, J. and Chuma, E., 2002. Enhancing the adaptive capacity of the resource users in natural resource management. *Agricultural systems*, 73 (1), 23–39.

Harris, R., 2001. The knowledge-based economy: intellectual origins and new economic perspectives. *International journal of management reviews*, 3 (1), 21–40.

Heerink, N., 2005. Soil fertility decline and economic policy reform in sub-Saharan Africa. *Land use policy*, 22 (1), 67–74.

Henao, J. and Baanante, C., 2006. *Agricultural production and soil nutrient mining in Africa: implications for resource conservation and policy development* [online]. 13 p. Available from: http://www.eurekalert.org/africasoil/report/Soil_Nutrient_Mining_in_Africa_Report_Final.pdf [Accessed 24 January 12].

Herrero, M., *et al.*, 2010. Smart investments in sustainable food production: Revisiting mixed crop-livestock systems. *Science*, 327 (5967), 822–825.

Hine, R. and Pretty, J., 2006. *Promoting production and trading opportunities for organic agricultural products in East Africa* [online]. New York and Geneva: United Nations Environment Programme (UNEP)–United Nations Conference on Trade and Development (UNCTAD) Capacity Building Task Force on Trade Environment and Development. Available from: http://www.unep-unctad.org/CBTF/events/arusha/Organic%20Ag%20East%20Africa%20final%20draft%202.pdf [Accessed 11 December 2007].

International Federation of Organic Agricultural Movements [IFOAM], undated. *The principles of organic agriculture* [online]. Available from: http://www.ifoam.org/about_ifoam/principles/index.html [Accessed 25 March 2008].

International Fertilizer Development Center [IFDC], 2008. *World fertilizer prices soar as food and fuel economies merge* [online]. Muscle Shoals, Alabama: IFDC, Available from: http://www.ifdc.org/i-wfp021908.pdf [Accessed 13 August 2010].

International Fund for Agricultural Development [IFAD], 2003. *The adoption of organic agriculture among small farmers in Latin America and the Caribbean: thematic evaluation* [online]. IFAD report no. 1337. Available from: http://www.ifoam.org/growing_organic/8_research/pdf/IFADorganicLatinAmerica.pdf [Accessed 27 October 2009].

Kilcher, L., Huber, B., and Schmid, O., 2006. Standards and regulations. *In*: H. Willer and M. Yussefi, eds. *The world of organic agriculture: statistics and emerging trends 2006*. Bonn: International Federation of Organic Agricultural Movements, and Frick, Switzerland: Research Institute of Organic Agriculture (FiBL), 91–95.

Kristjanson, P., *et al.*, 2009. Linking international agricultural research knowledge with action for sustainable development. *Proceedings of the national academy of sciences*, 106 (13), 5047–5052.

Kwesiga, F., *et al*., 2003. *Improved fallows in eastern Zambia: history, farmer practice, and impacts*. Environment and Production Technology Division (EPTD) Discussion paper no. 130, prepared for a workshop held in Pretoria, South Africa, 10–12 June 2002. Successes in African Agriculture. Washington: International Food Policy Research Institute (IFPRI).

Lichtfouse, E., *et al.*, 2009. Agronomy for sustainable agriculture. A review. *Agronomy for sustainable development*, 29 (1), 1–6.

Lin, B.B., *et al.*, 2011. Effects of industrial agriculture on climate change and the mitigation potential of small-scale agro-ecological farms. *CAB reviews: perspectives in agriculture, veterinary science, nutrition and natural resources*, 6 (020), 2–18.

Lotter, D., 2003. Organic agriculture. *Journal of sustainable agriculture*, 21 (4), 59–128.

Lyngbaek, A.E., Muschler, R.G., and Sinclair, F.L., 2001. Productivity and profitability of multistrata organic versus conventional coffee farms in Costa Rica. *Agroforestry systems*, 53 (2), 205–213.

Meertens, H.C.C., 1999. *Rice cultivation in the farming systems of Sukumaland, Tanzania: a quest for sustainable production under structural adjustment programmes*. Wageningen University dissertation no. 2651. Wageningen University, Wageningen, Netherlands.

Moebius-Clune, B.N., *et al.*, 2011. Long-term soil quality degradation along a cultivation chronosequence in western Kenya. *Agriculture, ecosystems and environment*, 141 (1), 86–99.

Mog, J.M., 2006. Managing development programs for sustainability: integrating development and research through adaptive management. *Society & natural resources*, 19 (6), 531–546.

Narrod, C., *et al*., 2007. The role of public-private partnerships and collective action in ensuring smallholder participation in high value fruit and vegetable supply chains. Paper prepared for a research workshop held in Cali, Colombia, 2–5 October 2006. *Collective action and market access for smallholders*. Washington: CGIAR Systemwide Program on Collective Action and Property Rights, c/o International Food Policy Research Institute.

Nonaka, I., 2005. Introduction. *In*: I. Nonaka, ed., *Knowledge management: critical perspectives on business and management*. London: Routledge, 1–2.

Oberholtzer, L., Dimitri, C., and Jaenicke, E.C., 2012. International trade of organic food: evidence of US imports. *Renewable Agriculture and Food Systems*. 1–8, doi:10.1017/S1742170512000191.

Organisation for Economic Co-operation and Development [OECD], 1999. *Managing national innovation systems*. Paris: OECD.

Parrott, N. and van Elzakker, B., 2003. *Organic and like-minded movements in Africa: development and status* [online]. Bonn: International Federation of Organic Agriculture Movements (IFOAM). Available from: ftp://ftp.fao.org/paia/organicag/africa.pdf [Accessed 26 September 2007].

Piesse, J. and Thirtle, C., 2009. Three bubbles and a panic: an explanatory review of recent food commodity price events. *Food policy*, 34 (2), 119–129.

Pimentel, D., 2011. Food for thought: a review of the role of energy in current and evolving agriculture. *Critical reviews in plant sciences*, 30 (1–2), 35–44.

Poulton, C., Kydd, J., and Dorward, A., 2006. Overcoming market constraints on pro-poor agricultural growth in sub-Saharan Africa. *Development policy review*, 24 (3), 243–277.

Pretty, J.N., *et al.*, 2006. Resource-conserving agriculture increases yields in developing countries. *Environmental science and technology*, 40 (4), 1114–1119.

Pretty, J., Toullmin, C., and Williams, S., 2011. Sustainable intensification in African agriculture. *International journal of agricultural sustainability*, 9 (1), 5–24.

Ravallion, M., Chen, S., and Sangraula, P., 2007. *New evidence on the urbanization of global poverty.* [online] World Bank Policy Research working paper 4199. Available from: http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2007/08/27/000158349_20070827111606/Rendered/PDF/wps419901update1.pdf [Accessed 2 August 2010].

Reardon, T. and Berdegué, J.A., 2006. *The retail-led transformation of agrifood systems and its implication for development policies* [online]. Santiago: Latin American Center for Rural Development (RIMISP), Available from: http://www.rimisp.org/getdoc.php?docid=6432 [Accessed 11 July 2008].

Reardon, T., *et al*., 2005. *Links among supermarkets, wholesalers and small farmers in developing countries: conceptualization and emerging evidence*. Proceedings of a conference held in Wye, UK, 26–29 June 2005. *The future of small farms*. Washington: International Food Policy Research Institute (IFPRI). (No longer available where accessed in 2007 but a version is available from http://www.ifpri.org/publication/future-small-farms-poverty-reduction-and-growth [Accessed 7 December 2009].

Röling, N., 2010. The impact of agricultural research: evidence from West Africa. *Development in practice*, 20 (8), 959–971.

Sahota, A., 2006. Overview of the global market for organic food and drink. *In*: H. Willer and M. Yussefi, eds. *The world of organic agriculture: statistics and emerging trends 2006*. Bonn: International Federation of Organic Agriculture Movements (IFOAM) and Frick, Switzerland: Research Institute of Organic Agriculture (FiBL), 69–73.

Sanchez, P.A., 2002. Soil fertility and hunger in Africa. *Science*, 295 (5562), 2019–2020.

Sanchez, P.A. and Swaminathan, M.S., 2005. Hunger in Africa: the link between unhealthy people and unhealthy soils. *Lancet*, 365 (9457), 442–444.

Santacoloma, P., 2007. *Organic certification schemes: managerial skills and associated costs: synthesis report from case studies in the rice and vegetable sectors*. Agricultural management, marketing and finance occasional paper 16. Rome: Food and Agriculture Organization.

Scialabba, N., Grandi, C., Henatsch, C., undated. *Organic agriculture and genetic resources for food and agriculture* [online]. Available from: http://www.fao.org/documents/show_cdr.asp?url_file=//docrep/005/ac784e/ac784e00.htm [Accessed 20 December 2009].

Setboonsarng, S., 2006. *Organic agriculture, poverty reduction, and the millennium development goals*. [online]. ADB Institute discussion paper no. 54. Tokyo: Asian Development Bank, 28 pp. Available from: http://www.unctad.org/trade_env/test1/meetings/bangkok7/ADBIorganicagriculturemdgs.pdf [Accessed 8 December 2007].

Setboonsarng, S., Leung, P.S., and Cai, J., 2006. *Contract farming and poverty reduction: The case of organic rice contract farming in Thailand*. ADB Institute discussion paper no. 49. Tokyo: Asian Development Bank Institute.

Shennan, C., 2008. Biotic interactions, ecological knowledge and agriculture. *Philosophical transactions of Royal Society B*, 363 (1492), 717–739.

Spielman, D.J., *et al.*, 2008. *Rural innovation systems and networks: findings from a study of Ethiopian smallholders*. International Food Policy Research Institute discussion paper no. 00759. Washington: IFPRI.

Sullivan, P., 2002. *Drought resistant soil* [online]. Fayetteville, Arkansas: Appropriate Technology Transfer for Rural Areas – National Sustainable Agriculture Information Service. Available from: http://attra.ncat.org/attra-ub/PDF/drought.pdf [Accessed 20 December 2009].

Taylor, A., 2006. *Overview of the current state of organic agriculture in Kenya, Uganda and the United Republic of Tanzania and the opportunities for regional harmonization* [online]. New York and Geneva: United Nations Environment Programme (UNEP)–United Nations Conference on Trade and Development (UNCTAD) Capacity Building Task Force on Trade, Environment and Development. Available from: http://www.enep-unctad.org/CPTF/publications/UNCTAD_DITC_TED_2005_16rev2.pdf [Accessed 29 December 2007].

Tripp, R., 2006. *Is low external input technology contributing to sustainable agricultural development?* London: ODI, Overseas Development Institute Natural Resource Perspective 102.

van der Vossen, H.A.M., 2005. A critical analysis of the agronomic and economic sustainability of organic coffee production. *Experimental agriculture*, 41 (4), 449–473.

Walaga, C., 2004. *Study visit report: Organic agriculture in Kenya and Uganda*. Wageningen, Netherlands: Technical Centre for Agricultural and RuralCooperation (CTA).

Walcott, J.J. and Wolfe, E.C., 2008. Estimating adaptive capacity in Australian farming environments. In: *Global issues, paddock action*. Proceedings of a Conference in Adelaide, South Australia, 21–25 September 2008. 14th Australian Agronomy Conference. Gosford, New South Wales: The Regional Institute Ltd. [online]. Available from http://www.regional.org.au/au/asa/2008/concurrent/emerging-opportunities/5819_walcottjj.htm [Accessed 25 October 2009].

World Bank, 2007. *World development report 2008: agriculture for development* [online]. Washington: World Bank. Available from: http://siteresources.worldbank.org/INTWDR2008/Resources/WDR_00_book.pdf [Accessed 8 February 2008].

Appendix: ORCA cases reviewed

Table A1. African and Latin American ORCA cases reviewed for this study.

			Yield			Price premium received?			Net income effect			Food security improved?		
Source	Country	Crop	+	−/=	NS	+	−/=	NS	+	−/=	NS	+	−/=	NS
Crucefix (1998)	Mozambique	Cotton		X			X			X			X	
Crucefix (1998)	Uganda	Cotton		X			X		X			X		
Hine and Pretty (2006)	Ethiopia	Vegetables, fruit	X					X	X			X		
Hine and Pretty (2006)	Kenya	Maize, fruit	X					X	X			X		
Gibbon and Bolwig (2007)	Uganda	Coffee	X					X	X					X
Gibbon and Bolwig (2007)	Uganda	Cocoa, vanilla	X					X	X					X
Gibbon and Bolwig (2007)	Uganda	Pineapple	X					X	X					X
Hine and Pretty (2006)	Kenya	Not stated	X					X	X			X		
Hine and Pretty (2006)	Malawi	Fish culture added to low input farms	X					X	X			X		
Crucefix (1998)	Egypt	Cotton, vegetables and herbs		X		X					X			X
Hine and Pretty (2006)	Kenya	Vegetables	X					X			X			X
Hine and Pretty (2006)	Kenya	Vegetables	X					X			X	X		
Hine and Pretty (2006)	Uganda	Mixed			X			X			X			X
Hine and Pretty (2006)	Tanzania	Cotton			X			X			X			X
Lyngbaek *et al*. (2001)	Costa Rica	Coffee		X		X				X				X
Caceres (2005)	Argentina	Vegetables, fruit	X				X		X			X		
IFAD (2003)	Mexico	Coffee	X			X			X					X
IFAD (2003)	Mexico	Honey		X		X			X					X
IFAD (2003)	Guatemala	Coffee	X			X			X					X
IFAD (2003)	D Republic	Bananas		X		X			X					X
Crucefix (1998)	D Republic	Bananas	X			X			X					X
Bray *et al*. (2002)	Mexico	Coffee	X			X			X					X

(*Continued*)

Table A1. Continued.

Source	Country	Crop	Yield			Price premium received?			Net income effect			Food security improved?		
			+	−/=	NS	+	−/=	NS	+	−/=	NS	+	−/=	NS
Damiani (2001)	Costa Rica	Cacao, bananas			X	X			X					X
IFAD (2003)	Argentina	Sugar		X		X			X					X
IFAD (2003)	El Salvador	Vegetables	X			X			X					X
Crucefix (1998)	Belize	Cacao	X			X			X					X
Van der Vossen (2005)	Mexico	Coffee		X			X			X				X
Van der Vossen (2005)	Mexico	Coffee		X			X			X				X
Crucefix (1998)	Mexico	Coffee			X	X					X			X
Bacon (2005)	Nicaragua	Coffee			X	X					X			X
Santacoloma (2007)	Brazil	Vegetables, fruit			X			X			X			X
Totals			16	9	6	14	5	12	19	4	8	7	1	23

Legend: +: increased over non-ORCA; −/=: decreased or stayed the same; NS: not stated

Table A2. Asian cases reviewed for initiative management information.

Asia Source	Number of cases reported	Countries
Giovannucci (2005)	13	China, India
Santacoloma (2007)	4	India, Thailand