Stimulating Smallholder Investments in Sustainable Land Management: Overcoming Market, Policy and Institutional Challenges

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1. Introduction

The degradation of natural resources raises a variety of issues related to rural livelihoods, poverty, distribution of income and inter-generational equity. Land degradation also deprives smallholders and particularly the poor of a key resource and diminishes capacity to undertake critical investments, possibly leading to depletion of buffer stocks and increased vulnerability. These problems are most pronounced in areas with widespread poverty and fragile ecosystems such as arid, semi-arid and highland regions (Pender and Hazell, 2000; Shiferaw and Bantilan, 2004). In such areas sustainable intensification of agriculture through land conservation and management is a critical policy challenge.

In recognition of the importance of land degradation for rural livelihoods, governments and development partners in East Africa have devoted substantial resources to developing and promoting soil and water conservation technologies. These methods are diverse and include both indigenous and introduced practices for combating soil erosion and nutrient depletion, improving water conservation and enhancing productivity. Structural methods are often promoted through donor financed projects (e.g. food for work) and include soil or stone bunds and terraces. Agronomic practices include minimum tillage, organic and inorganic fertilizers, grass strips and agro-forestry. These techniques aim to reduce soil erosion while increasing organic matter and

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increasing nitrogen fixation. In addition, water harvesting techniques like tied-ridges, planting basins, check-dams, ponds, tanks and bore wells provide farmers the opportunity to plant early and better utilize available moisture for plant growth and reduce reliance on unpredictable rains (Baidu-Forson, 1999).

Despite the growing policy interest, widespread adoption of sustainable management techniques outside of intensively supported projects has been limited (Fujisaka, 1994; Pender and Kerr, 1998; Barrett *et al*, 2002). A review of the literature suggests that while there is still inadequate understanding of the role of market, policy and institutional factors in shaping incentives for adoption, deficiencies in terms of market and policy failures can create important barriers to smallholder adoption of sustainable land management (SLM) (Zaal and Oostendorp, 2002).

This chapter reviews the challenges smallholder farmers face in tackling the long-standing problem of land degradation and offers new insights into how market incentives, institutional factors and macroeconomic policies affect adoption and adaptation of land and water management technologies. The paper is organized as follows. Section two discusses the evolution of approaches to soil and water conservation. Section three provides a broad conceptual framework for analysis and evaluates challenges. Section four presents a review of factors that condition the use of sustainable land and water management. Lastly, section five offers conclusions, key lessons and implications for policy and future research.

2. Evolution of Approaches for Sustainable Land and Water Management

Concern with land and water degradation in smallholder agriculture is not new. Over the years considerable effort has gone into getting smallholder farmers to mitigate land degradation and adapt existing techniques to local conditions. Reducing soil erosion and associated nutrient depletion has been a particular priority and due to off-site effects like siltation of reservoirs and waterways, governments have often intervened to reduce soil erosion and runoff in hilly areas. In semi-arid regions the focus is often on capturing and utilizing surface and groundwater. Most efforts have met limited success.[2]

Conservation promotion approaches can be grouped into top-down, populist or farmer-first and neo-liberal (Biot *et al*, 1995). Most of the land management interventions by colonial governments were top-down command-and-control type policies that did not involve smallholder farmers and were driven by fear of inaction. Policies included forced adoption of erosion control, planting of trees and protection of water/river catchments. Until the mid-1980s several countries in East Africa used similar policies (e.g. see Shiferaw and Holden, 1998; Pandey, 2001). These approaches largely failed and created serious barriers to innovation.

The failure of command-and-control led to the so-called "populist" approach, which largely rejected external technology development and extension and made the farmer the center of soil and water conservation programs. Chambers *et al* (1989) is emblematic of this approach, stressing small-scale, bottom-up interventions, often using indigenous technologies (Reij, 1991). Although the idea of putting farmers first is noble, implementation was difficult, leading to a broader approach in which farmer innovation is affected by economic, institutional and policy environments (Biot *et al*, 1995; Robbins and Williams, 2005).

[2] Using studies in Niger, Tabor (1995), for instance, points out that despite holding tremendous promise for increasing crop yields in semi-arid lands, applications of water-harvesting technologies are not terribly widespread.

The neo-liberal approach focuses on incentives that prevent the use of land and water management technologies. This framework recognizes the role of farmer innovation, but highlights the critical role of markets, policies and institutions for farmer innovation, adoption and adaptation. The critical importance of making conservation attractive and economically rewarding to farmers through productive technologies and access to markets are regarded as key to success.

Growing recognition of the public good characteristics of soil and water conservation and the non-technical factors that condition technology choice have led to strategies that internalize local externalities at the community and landscape levels (Pagiola, 1998; Reddy, 2005; Kerr *et al*, 2007). Soil conservation provides off-site benefits that include better water quality and flood control for downstream users (Ribaudo, 1986; Fox *et al*, 1995; Colombo *et al*, 2006). Integrated watershed management (IWM) aims to improve both private and communal livelihoods through technological and institutional interventions. IWM goes beyond traditional soil and water conservation to include collective action, networking and market-related innovations that support and diversify livelihoods. This concept ties together the watershed with community and institutional factors that determine viability and sustainability. Linking the watershed with the community can help develop technologies and local collective action to internalize externalities and stimulate investments that address community-wide resource management problems (Shiferaw *et al*, 2008a).

In the last few years soil and water conservation has recognized design complexities and the need for broadening partnerships and disciplinary analyses and moved toward sustainable land/water management (Robbins and Williams, 2005). There is no single definition for SLM. Hurni (2000) suggests that SLM implies “a system of technologies and/or planning that aims to integrate ecological, socioeconomic and political principles in the management of land for agricultural and other purposes to achieve intra- and inter-generational equity." The following section builds on this concept of SLM and develops a conceptual framework for understanding the market, policy and institutional factors that affect investment in conservation. Understanding the drivers of these decisions will allow the design of win-win SLM strategies that reduce poverty and increase agricultural output.

3. Conceptual Framework

Small farmers in many developing regions produce and consume the same commodities, which means that investments in land and water management are likely to be influenced by factors related to both production and consumption. This is especially true when farmers operate under imperfect information and market conditions that prevent them from producing for sale and profits. Our framework presented in Figure 1 presumes that farm households pursue livelihood strategies constrained by a variety of factors as they make decisions about natural resources and investments. The framework is premised on Chambers (1987) and the farmer-first principles, but also incorporates farm household behavior under market imperfections (de Janvry *et al*, 1991), economics of rural organization (Hoff *et al*, 1993), economic policies (Heath and Binswanger, 1996) and institutions (North, 1990).

Figure 1 here

Smallholder farmers make production and investment decisions in each period to maximize net benefits, subject to existing assets and expected shocks. These two factors determine vulnerability. Decisions are affected by socioeconomic and policy environments, institutional changes and infrastructure that determine relative prices and access to technologies and markets (Shiferaw and Bantilan, 2004). Market access is further influenced by information imperfections and the high search costs that prevail in many developing countries (Fafchamps and Hill, 2005).

Institutional factors affect sustainable land and water management through legal frameworks, property rights and farmer participation in networks. In cases like watershed management, collective action may support individual production and investments.

Household assets and the prevailing biophysical, socioeconomic and institutional environments jointly determine the livelihood options and investment strategies available to farmers. Access to input and output markets, technologies and the resulting prices then define the feasible production set and determine the optimal investment strategies. Enabling and efficient institutions (e.g. secure rights to land and water and functioning credit and extension systems) also support investments that provide opportunities to intensify production, diversify livelihood strategies and potentially combat resource degradation.

The interplay of technological and institutional factors can spur households to pursue potentially sustainable intensification that improve livelihoods. In the absence of enabling policy and institutional environments that encourage technological innovation, farmers lack the incentives to use SLM technologies. Indeed, lack of viable technological options and adverse biophysical, policy and institutional environments can encourage exploitative and unsustainable livelihood strategies, leading to synergies between poverty and resource degradation and potentially downward spirals (Scherr, 2000).

Efficient use of SLM is also affected by SLM's public good nature. The costs of conserving land and water are paid by investors, but the benefits accrue to agents well beyond the farm. Significant offsite SLM benefits present challenges, because they can lead to under-investment. This is particularly true when, as is often the case, the effectiveness of conservation investments depends on treating an entire catchment or micro-watershed; this requires collective action and landscape-wide cooperation, but such cooperation often involves costs and leads to additional market failures. These issues are discussed further in Section 4.

4. Determinants of Conservation Investments

Investment in SLM is often just one of many investment options available to farmers. One way to model behavior is to suppose farmers compare the expected costs and benefits of all options and invest in those that offer the highest net returns (Kerr and Sanghi, 1992; Pagiola, 1998; Lee, 2005); farmers therefore switch from old to new methods when they gain in terms of net returns, lower risks or both. Particularly with large off-site benefits, highest private returns might come from investments other than in soil and water conservation; adoption will therefore be inhibited unless subsidies are offered.

The conceptual framework presented in Section 3 identifies factors that condition the adoption and adaptation of soil and water management intervention in smallholder agriculture. In the context of Figure 1, in addition to environmental factors, determinants can broadly be categorized as policy and institutional and market, poverty and risk. These are discussed below.

4.1 Agricultural Policy and Institutional Factors

In the past decade there has been an increasing recognition that policy and institutional arrangements play important roles in sustainable management of natural resources (Heath and Binswanger, 1996; Barbier, 2000; Pandey, 2001; Zaal and Oostendorp, 2002; Reddy, 2005). We focus on some of the most direct influences of agricultural policies on SLM investments. Though there is a movement to reintroduce some targeted subsidies for fertilizer, seeds and irrigation (Kelly *et al*, 2003), unlike in some Asian countries (e.g. India), most countries in sub-Saharan Africa (except Malawi) have done away with agricultural input and investment subsidies. Public support for irrigation water and infrastructure is an important example.[3] In India, as in many Asian countries, irrigation water is typically free and electricity subsidized (Reddy, 2005). These policies distort incentives and can create disincentives for investment in soil erosion control and conservation of available water (Reddy, 2005; Shiferaw *et al*, 2008a). They can also encourage the planting of water-intensive crops, often in semi-arid regions, and SLM investments may be short-lived as farmers resort to old practices once subsidies are withdrawn. The bottom line is that while subsidies can be justified by market and institutional failures, there is a need for careful appraisal of such policies.

Institutions are the rules, enforcement mechanisms and organizations that help shape expectations and behavior and facilitate market and non-market transactions. They transmit information, mediate transactions, facilitate collective action, regulate property rights and contracts and help internalize externalities. Of special importance for SLM are property rights, collective action and social networks.

Access and security of rights to land, water and other natural resources are important, because if property rights are weak farmers cannot capture the full benefits of their investments and therefore incentives to invest in SLM may be reduced (Ahuja, 1998; Barrett *et al*, 2002; Shiferaw and Bantilan, 2004). However, empirical evidence on the effect of land ownership rights on SLM is mixed. Knowler and Bradshaw (2007) review thirteen studies that assess the impact of land ownership on adoption of SLM in several countries. They find that in two cases owned land is better maintained, but in three cases the opposite is found and in the rest there is no relationship.

When SLM provides important flood and soil erosion control in community watersheds there are public goods externalities and incentives for private investments may be limited. In such

[3] The effect of agricultural price and non-price subsidies and the importance of public investment in transport infrastructure and the associated effects of improved market access and competitiveness on SLM will be discussed in the following section.

cases interdependence of resource users will require collective action and cooperation to achieve socially desirable conservation outcomes. Evidence suggests policies and institutions that induce and sustain collective action can play a significant role in the conservation and management of communal resources. Ahuja (1998) and Gebremedhin *et al* (2003) examine the effects of collective action on adoption of conservation technologies in Cote d'Ivore and Ethiopia and find that collective action supports adoption of conservation practices by helping farmers address market failures and overcome information constraints.

Networking among farmers, including participation in the design of land management technologies, has an important role in influencing farmers' attitudes and perceptions. Networking facilitates access to information about benefits and risks and as we have seen lack of farmer participation may explain why many past interventions failed (Reij 1991; Tiffen *et al*, 1994; Robbins and Williams, 2005). In contrast, participatory interventions incorporating collective action have been relatively more successful (Joshi *et al*, 2004; Shiferaw *et al*, 2008b). Technologies resulting from such processes take into account the unique socio-economic characteristics of farmers, allowing adaptation to specific circumstances. Farmers are able to test practices at their own pace and in their preferred sequences, typically leading to compatibility with local farming systems (Robbins and Williams, 2005). Participatory approaches also allow farmers to gradually adapt technologies to changing conditions (Bunch, 1989) and learn from one another.

4.2 Markets, Poverty and Risk

Studies that examine the relationship between commodity prices and land and water management find mixed effects (Barrett, 1991; Bulte and van Soest, 1999; Litchenberg, 2006). The ambiguous effects are not surprising, because higher commodity prices increase the returns to land management and therefore land value (Litchenberg, 2006), but also can make soil degradation more attractive than other possibilities. For instance, increases in the price of agricultural outputs can mask the effect of land degradation, making erosive practices attractive to farmers. When conservation does not provide obvious financial returns, an increase in the price of an erosive crop may encourage expansion without investment in SLM. In other cases, though, increased commodity prices may make SLM profitable for farmers and a number of studies find positive relationships between prices and adoption (e.g., Bulke and van Soest, 1999; Shiferaw and Holden, 2000; Lee, 2005). Shiferaw and Holden (2000), for example, find that in highland Ethiopia when conservation offers short-term gains, increases in prices spur adoption of SLM.

Government price supports can undermine sustainable land management by distorting the incentives faced by resource users. Price supports to irrigated crops like rice and wheat can discourage farmers in semi-arid areas from cultivating sorghum and other water-efficient crops. Well-intentioned policies to promote food security could therefore lead to extensive land degradation and depletion of groundwater resources.

A major determinant of adoption is cost, its absolute magnitude and relative to benefits. An increase in the price of fertilizer, for example, generally reduces its application (Pattanayak and Mercer, 1997). However, fertilizer subsidies can result in land degradation as found in China and South Asia (Pingali and Rosegrant, 1994; Heerink *et al*, 2007). Heerink *et al* (2007) find, for example, that policies to lower the fertilizer-rice price ratio have lead to compaction and soil degradation. Other studies investigate how the cost of hedgerow cropping, terracing, minimum tillage, no tillage, etc and agricultural water harvesting techniques affect adoption and find inverse relationships between cost and adoption (Pattanayak and Mercer, 1997; Baidu-Forson, 1999; Robins and Williams, 2005).

A number of studies examine the role of market access on use of SLM. Most find that when farmers face the costs of land degradation, land rights are clear and supportive policy and institutional mechanisms exist, improving access to commodity and input markets reduces transaction costs and improves the likelihood of SLM adoption (Reardon *et al,* 1997; Zaal and Oostendorp, 2002). For example, the largely semi-arid Machakos district in Kenya suffered serious soil erosion problems in the 1930s due to failed colonial soil conservation policies, but by the mid 1980s the district had largely brought soil erosion under control while also increasing per capita income (Tiffen *et al*, 1994; Pagiola, 1998; Barbier, 2000). This tremendous success has partially been attributed to market access caused by good road infrastructure and proximity to Nairobi (Pagiola, 1998; Zaal and Oostendorp, 2002; Robbins and Williams, 2005). Zaal and Oostendorp (2002) indeed argue that the commercialization of agriculture generated the incomes needed to finance SLM investments. The effect can also move in the opposite direction; Shiferaw *et al* (2008b) find evidence from Adarsha watershed in India that adoption of land management and complementary technologies for improving productivity help farmers diversify into high value and marketable crops. This suggests that SLM can reduce production risks, increase marketable surplus and facilitate the transition from subsistence to commercial farming.

The relationship between labor market performance and investments in SLM are quite mixed (Reardon and Vosti, 1997; Pender and Kerr, 1998; Holden *et al*, 2004; Robins and Williams, 2005). In the Ethiopian highlands where on-farm returns to family labor are low, Holden *et al* (2004) show that increased opportunities for off-farm employment have positive effects on household welfare, but reduce conservation investments. Similarly, Shiferaw and Holden (1998) find a negative relationship between off-farm income orientation and maintenance of conservation structures. Pender and Kerr (1998) find that when labor and credit markets work poorly, higher income households are more likely to invest in SLM. Kerr and Sanghi (1992) find fewer conservation investments around large Indian cities with active off-farm labor markets than in more remote areas. Reardon and Vosti (1997) find similar results in their study of Rwanda, Burundi and Burkina Faso.

In contrast to these findings, Tiffen *et al* (1994), Pagiola (1998) and Scherr (2000) review cases across Sub-Saharan Africa where off-farm employment increases soil and water conservation investments, perhaps by reducing the intensity of resource use. But generally the literature finds the opposite and offers two main reasons for the negative relationship between labor market performance and SLM investments. First, all else equal when labor markets work well workers face higher opportunity costs and prefer to allocate labor off-farm. Second, off-farm employment often overlaps with the slack season and reduces labor available for conservation.

Another important factor conditioning adoption and adaptation of conservation technologies is risk. Smallholder farmers face constant difficulties managing health, climate and socioeconomic shocks and SLM interventions that increase variability or uncertainty of incomes tend to be shunned by farmers. Such risks can arise from greater crop failure (due to biotic and abiotic stresses), poor and unreliable access to markets or insecure property rights. Whereas soil and water conservation generally tends to reduce production risks, there may be circumstances when risks increase. For example, Shiferaw and Holden (1998) find that in Ethiopia soil and stone bunds cause pest infestation and even flooding. An example where SLM reduces risk is water harvesting and irrigation in semi-arid areas used as part of strategies to cope with and adapt to drought and climatic shocks (Shiferaw *et al*, 2008b). In addition to risks associated with conservation technologies, uninsured production risk may cause farmers to under-invest in all areas, including SLM (de Janvry *et al*, 1991).

Product, credit, labor and insurance markets in rural areas of many developing counties tend to be either missing or highly imperfect. Input and output market access is often constrained by poor transport and communication infrastructure, fragmented supply chains, resulting in high transaction costs that undermine commercialization (Fafchamps and Hill, 2005; Poulton *et al*, 2006) and reduced SLM adoption (Pender and Kerr, 1998). Using large-scale survey data from Uganda, Pender *et al* (2004) test the effect of distance to all weather roads and nearest markets on commercial crop production and soil erosion. They find that market distance is not correlated with production or erosion. Pender and Kerr (1998) examine the impact on SLM adoption of incomplete and missing input and output markets in semi-arid areas of India. They find that both reduce profitability of investments and adoption.

Access to credit is especially important for adoption of land management interventions like irrigation, terracing, tree planting, and fertilizer use, because of heavy upfront cash requirements (Holden *et al*, 1998; Shiferaw and Holden, 2000), but in most rural areas in East Africa credit markets work very poorly. Households must therefore rely on their own assets and several studies show that assets (including human capital) influence investments in conservation (Reardon and Vosti, 1995; Holden *et al*, 1998; Scherr, 2000; Swinton and Quiroz, 2003). The role of education and other forms of human capital on adoption of land management interventions has been particularly widely studied (e.g. Knowler and Bradshaw, 2007). Human capital increases the likelihood farmers perceive land degradation as a problem and may increase managerial ability, helping farmers process information about technologies. However, if off-farm options like migration and nonagricultural wage employment are available, more education can increase the opportunity cost of labor and reduce incentives to invest (Swinton and Quiroz, 2003)

Most land management investments like the *fanya juu* terraces promoted in the Machakos District of Kenya require large initial investments, but deliver a flow of benefits over many years. Due to imperfect capital markets and associated high costs of borrowing combined with limited own resources, most resource-poor farmers have short planning horizons (Holden *et al*, 1998). These horizons can discourage adoption of technologies that may not offer immediate benefits, but as illustrated in Figure 2 improve livelihoods only in the long run.

Figure 2

Using Figure 2 let us assume Options 1 to 4 offer different income streams from adoption. The resource degrading practice is Option 1, with incomes falling over time. Under the next best conservation option (Option 2) incomes decline too, but more slowly. As is typical for many land management investments, net income in the first few years is lower than without investment, but higher thereafter. At the same time, such investments tend to generate external benefits that farmers often omit in their computation of benefits. For instance, investment in soil conservation can reduce degradation of downstream fishing grounds and irrigation water bodies. Evidence indicates that if farmers face only these two alternatives, resource-conserving technologies are unlikely to be adopted (Holden *et al*, 1998), because in environments of imperfect markets poor farmers lack the capacity to absorb initial income losses. Unless subsidized, farmers may not be interested in such options (Shiferaw and Holden, 2001; Pagiola *et al*, 2002).

Alternatively, if farmers have access to Options 3 and 4, there will not be such tradeoffs between current and future incomes and one would expect widespread adoption. A key challenge is that many of the available SLM technologies are not like Options 3 and 4. Identifying, developing and promoting the most suitable SLM technologies and making those approaches incentive-compatible in environments of highly imperfect markets is perhaps the most important challenge facing promoters of SLM.

5. Conclusions and Policy Implications

This chapter reviewed the challenges that small farmers face in tackling land degradation and presented a broad conceptual framework for understanding SLM investments within the context of imperfect factor markets, inadequate property rights and weak organizational and institutional arrangements. Our review of the literature suggests that resource poor farmers, especially in marginal and rain fed regions, face complex challenges in adopting and adapting land management innovations. Approaches to soil and water conservation have evolved over time, with the conventional wisdom now encouraging farmer participation and consideration of the market, policy and institutional factors that shape behavior.

Farmer participation in the design of conservation technologies and availability of information about potential benefits and risks have important roles to play in influencing farmers' attitudes and perceptions. Past interventions that followed top-down approaches failed and were subsequently replaced by participatory conservation that takes into account the unique socio-economic characteristics of farmers, allowing adaptation to specific circumstances; linking research with indigenous innovation processes may be especially important.

Some types of land degradation may not be directly visible to farmers, especially when external factors make it difficult for farmers to attribute changes to declining resource quality. Farmers will adopt technologies only if they perceive soil and water degradation as a problem that affects their livelihoods (Fujisaka, 1994; Cramb *et al*, 1999; Baidu-Forson, 1999). Along with participatory design, education about new options and the process of resource degradation are critical to stimulating awareness and action by individuals and communities.

Commercialization of agriculture and better market integration generally raises the returns to land and labor in agriculture. When complemented by policies and institutional mechanisms to induce innovation and adoption, thicker more accessible markets can be important drivers of sustainable intensification. Given that poverty and lack of farmer capacity can be major limiting factors, access to credit at affordable rates and availability of pro-poor, profitable conservation technologies are key steps.

Unless conservation provides higher expected benefits than unsustainable options, farmers cannot be expected to adopt them and several studies have shown that the net gain from adoption of SLM can be negative. In the presence of significant market failures and when the social gains are higher than the costs, conservation subsidies may be justified. With pervasive offsite effects and market failures that hinder landscape-wide interventions, stimulating wider use of SLM will also require new kinds of institutional mechanisms for empowering communities through collective action. This chapter has shown that the interests of smallholder farmers and society may not always coincide in attaining social objectives for sustainable use and management of land, water and other vital resources. There is a critical need for additional research to identify policies and institutional reforms that overcome market and policy failures in smallholder agriculture and stimulate investments in SLM. One of the most innovative approaches to help poor smallholder farmers adopt more sustainable practices is payment for environmental services (PES). Under PES beneficiaries of environmental services compensate farmers who invest in protection and supply of ecosystem services (Pagiola *et al*, 2002; Pagiola *et al*, 2005). Pagiola *et al* (2005) find that PES schemes can reduce poverty while internalizing the external benefits of conservation. There is a need to test, develop and adapt such innovations to create greater incentives for beneficial conservation of land, water and agro-ecosystems in the African region.

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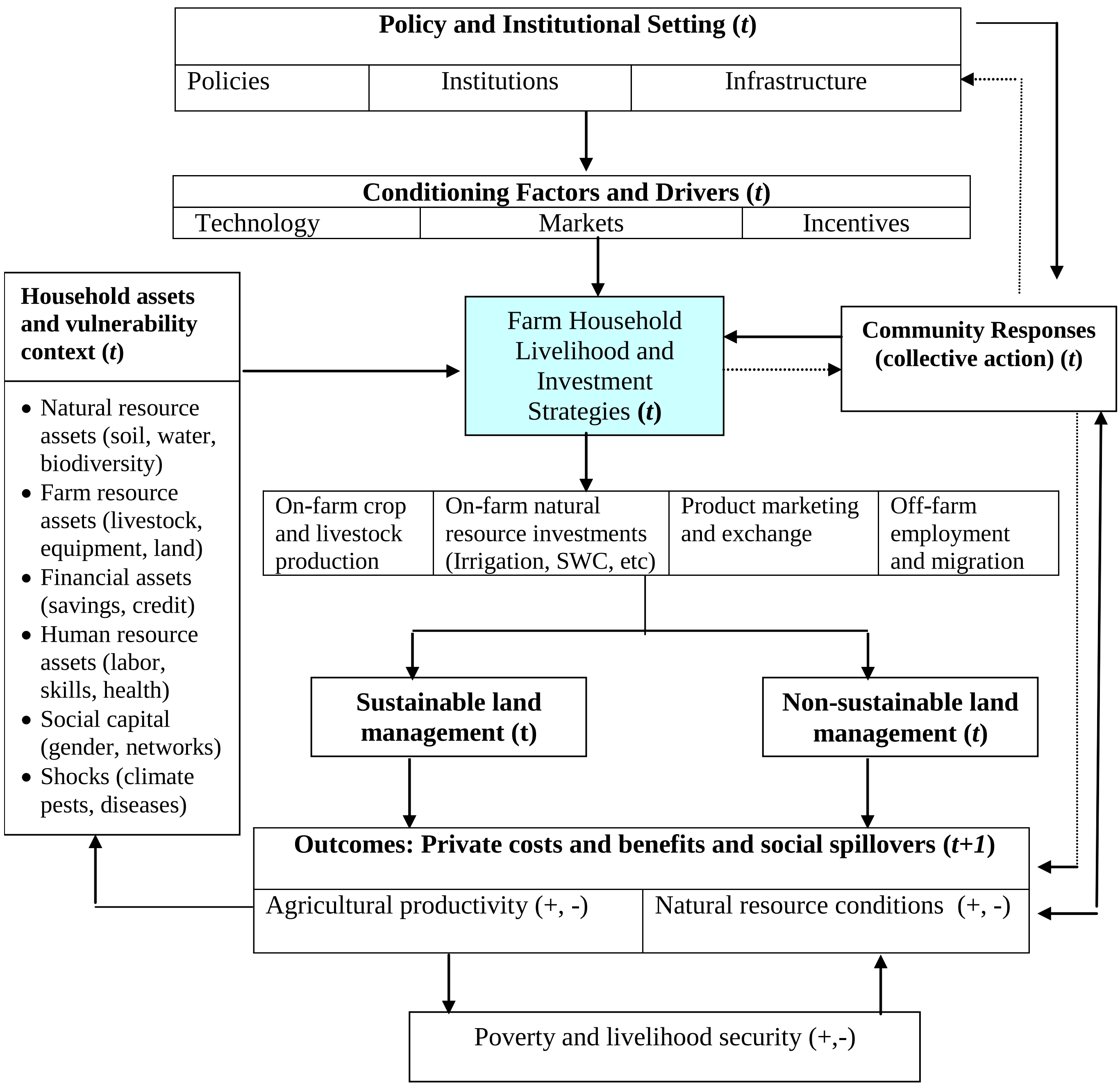

Figure 1. Factors conditioning smallholder natural resource investments and development pathways