



# **Raising agricultural productivity**

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Conference Paper nº 12

**III CONFERÊNCIA INTERNACIONAL DO IESE**

***“MOÇAMBIQUE: ACUMULAÇÃO E TRANSFORMAÇÃO EM CONTEXTO DE CRISE INTERNACIONAL”***

(4 & 5 de Setembro de 2012)

IESE Conference,

Maputo, 4-5 September 2012

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### **Abstract**

To increase the productivity of small-scale producers is the declared priority of poverty-reduction (PARP) programmes in Mozambique. Strategies to achieve this goal, set out in the PEDSA, strongly adhere to guidelines for sub-Saharan Africa in the Comprehensive African Agricultural Development Programme (CAADP) designed under the auspices of NEPAD. These incorporate actions that are both broad in scope (improved technology, easier market access, supportive institutions and better natural resource conservation) and 'vertically' distributed at every stage of agricultural 'value chains'. While there is little doubt that agricultural productivity needs to rise in sub-Saharan Africa as a whole, and in Mozambique in particular, this paper questions whether the current CAADP/PEDSA/PARP approach is adequate to guide government policy. It argues that this approach is likely to lack focus, and hence effectiveness, because it engages insufficiently with either the specific conditions of Mozambican agriculture or with specific (and explicit) political or economic goals of Mozambican development. The paper uses the findings of empirical research in both Mozambique and other parts of southern Africa to identify what questions need to be addressed in order to identify priorities for government. Specifically it will seek to consider questions concerning the analysis of 'value chains', the assessment of 'viability' of farming at different scales, and the relationship between (re)structuring of agricultural production and socio-economic differentiation.

### **1. Introduction:**

The Plano de Acção para Redução da Pobreza 2011-2014 (PARP) follows two earlier phases of poverty-reduction planning in Mozambique: the Planos de Acção para Redução da Pobreza Absoluta (PARPA I in 2002 – 2005, and PARPA II in 2006 - 2010). While many elements of the PARP can be identified in the earlier PARPA II, the new Plan departs from its predecessor in giving primary emphasis to promoting economic growth, particularly within the small-scale 'family sector' in agriculture and fisheries. This increase in attention to agriculture, and small-scale production in particular, is stated as responding to a situation in which overall poverty levels have essentially remained undiminished in Mozambique since 2002, and have shown a tendency to increase in rural areas (GdM 2011a, p8).

The focus on small-scale agriculture may be seen as a response to criticisms that earlier poverty reduction strategies, and particularly the PARPA II, relied too much on the private sector to generate the conditions for agricultural productivity growth among the small-scale producers that form the bulk of the rural population, and urging greater government intervention to support small-scale agriculture (Mosca 2010, Cunguara and Hanlon 2010, Tvedten *et al.* 2010). It is also relevant that the World Bank has recently advocated a focus on agriculture, and small-scale agriculture in particular, as an engine of growth in Africa (World Bank 2007). Comparison between the PARPA II and PARP documents shows a clear shift in emphasis, with agricultural and fisheries productivity occupying a primary place in the latter, compared to only ten paragraphs in PARPA II (GdM 2006, pp125-127). However, the way the problems of agriculture in Mozambique are characterised is very similar in both documents: low productivity of 'family' farming is attributed to inadequate access to productive technology and inputs and 'weak' markets for agricultural outputs due to poor infrastructure and inadequate access to financial services (e.g. credit) for agricultural producers. In both documents the emphasis is on how small-scale agriculture falls short of conditions considered necessary for high productivity and income. By contrast, there is little

information, even within the PARP 2011-2014, to give a sense of the nature of existing agricultural production and agricultural markets and how these are changing in contemporary Mozambique. There is, for example, a total absence of any mention of the large-scale investments in agriculture currently agreed with foreign and national commercial companies. As a consequence of this omission, the PARP can provide only a partial analysis of the contemporary context, and therefore little sense of how increased investment might be channelled to achieve greater use of productive technology and better market access among small-scale producers. While there is little doubt that agricultural productivity needs to rise in sub-Saharan Africa as a whole, and in Mozambique in particular, this paper argues that the current PARP approach, and the strategic agricultural development programme (PEDSA) associated with it, is heavily reliant on generic diagnoses of African agriculture generated by the NEPAD CAADP. It argues that this approach is likely to lack focus, and hence effectiveness, because it engages insufficiently with either the specific conditions of Mozambican agriculture or with specific (and explicit) political or economic goals of Mozambican development. The paper uses the findings of empirical research in Mozambique and other parts of southern Africa to identify what questions need to be addressed in order to identify priorities for government policy. Specifically it will seek to consider questions concerning the analysis of 'value chains', the nature of technical constraints and technological options, the assessment of 'viability' of farming at different scales and its relationship to (re)structuring of agricultural production and socio-economic differentiation.

## **2. The 'diagnostic' of agriculture within PARP.**

The definition of the problems of the agricultural sector contained in the PARP are set out in more detail in the ministry of agriculture's Strategic Development Plan for the Agricultural Sector 2011-2020 (PEDSA) approved by the council of ministers in the same month as PARP (GdM 2011b). The PEDSA identifies four 'pillars' for agricultural policy: i) to raise agricultural productivity growth through technological improvement; ii) increased market access through improved market infrastructure and services; iii) improvements in natural resource management; iv) more supportive institutions (farmer organisations, state agencies, education and training). The model adopted by the PEDSA reflects 'four pillars' also used to characterise the Comprehensive African Agricultural Development Programme (CAADP 2012) developed by the NEPAD in partnership with a number of international agencies since 2003 to guide agricultural development in sub-Saharan Africa. The four pillars are not exactly the same in PEDSA and CAADP, but overlap substantially in terms of the changes they promote. The two also adopt the same overall target of increasing agricultural output by 6% per year. In the PARP, this goal is higher, at 10.8% agricultural growth per year.

The relationship between PEDSA and CAADP is also evident in the emphasis on a 'comprehensive' specification of the challenges to improving African agriculture. This is understandable, and even laudable, in documents that seek to establish the scope for policy and intervention. However, it has the effect of elaborating long lists of actions that are needed, but without conveying any sense of priority or sequence of these actions. Indeed, in some instances the strategic objectives appear to reflect the priorities of international relations, rather than national or local agricultural concerns. Mosca and Selemene (2012, p9 footnote) and Cunguara and Hanlon (2010), have argued that agricultural policy documents produced in Mozambique over the past decade reflect the influence of policy requirements stipulated by bilateral and multilateral funders as conditions for funding Mozambican government budgets. This also points to one reason why the structure of the four 'pillars' appear as separate 'independent variables' ('technology', 'market access', 'natural resource conservation' and 'institutions') with little linkage between them, while, in practice, the 'pillars' are interdependent, and linked in ways determined by the goals of agricultural policy. So, for example, credit and market access exist for small-scale producers of tobacco, but are

problematic for those producing maize. The 'pillars' can thus only be useful to characterise agricultural constraints if they are articulated with specific agricultural goals.

Failure to establish the wider economic or political goals of agricultural policy leaves a lack of clarity on 'entry points' through which investment can be effective. This is exemplified by the way the problems of agricultural markets are characterised in the PEDSA as a list of seven 'deficiencies':

“O deficiente manuseamento pós-colheita dos produtos, a falta de infra-estruturas adequadas de armazenamento, a insuficiente aplicação de normas de qualidade dos produtos, a falta de acesso ao crédito para comercialização, a fraca disponibilidade de informação sobre mercados e preços, a falta de serviços de extensão para a comercialização e a ausência de associações fortes de camponeses, inibem o estabelecimento de ligações mais próximas e equitativas entre os agricultores e os mercados e o funcionamento efectivo dos mercados de insumos e de produtos agrários“ (GdM 2011b, p20).

The paragraphs that followed this statement provided a little more insight, for example that the poor standard of storage typically available to small-scale producers requires them to sell their crops immediately after harvest when prices are lowest. Low prices, in turn, inhibit investment in improved production technology. Lack of road infrastructure linking the more agriculturally productive northern region with the main consumption centres in the south is a major factor depressing agricultural prices in the regions with the highest potential to increase production. While these are important observations of structural factors blocking the adoption of more productive technology, they are not translated into any hierarchy of operational priorities. This lack of indications of 'where to start?' seems further accentuated by the commitment within PEDSA to intervene “throughout the value chain (cadeia de valor)”.

The limits of this 'comprehensive' approach to analysing agricultural problems becomes evident in PEDSA part III “Implementação da estratégia”. This identifies a strategy of concentrating effort where it will have greatest multiplier effects at national scale. In particular, efforts are to be focused on infrastructure and technological improvement in high-potential agricultural areas, the expansion of 'conservation agriculture' and the development of agricultural value chains in six 'development corridors' (Pemba-Lichinga, Nacala, Vale do Zambeze, Beira, Limpopo, Maputo). Indeed, it seems logical to support agricultural development in areas where demand is likely to be growing. However, the 'value chains' to be supported are expressed in terms of Research Centres (one for each 'corredor') and types of product. Thus, technological support for agriculture in the Nacala corridor is to be based at the Centro de Investigação Nordeste in Nampula, focusing on cassava, maize, cotton, 'fruta', poultry (frangos) and groundnut. The important point here is that support is characterised in terms of historic competences (determined by agro-ecological criteria) of existing research centres, not in terms of current developments of agricultural markets (or, indeed, 'value chains'). As a consequence, the list of research centres and the products which they are to support appears little different from lists that were drawn up 20 or 30 years earlier. There are grounds to argue that this relatively unchanging 'supply-side' focus, determined by agro-ecological criteria of 'production potential', may obscure an understanding of how market demand for agricultural production is changing and posing new questions about the nature of constraints to raising production. Two examples in the Nacala corridor are the increase in exports of non-cereal grain crops (sesame, beans), and the rapid rise in demand for soya for poultry ration as a consequence of expanding poultry production in the vicinity of Nampula City. None of these crops feature as priorities listed above for technical support from Centro de Investigação Nordeste in Nampula.

In order to identify more useful starting points for a strategy to increase productivity, analysis can start from three sets of questions. The first concerns the structure and dynamics of

demand for agricultural output, fundamentally determined by the non-agricultural economy driven by processes of urbanisation, industrialisation and regional and international trade. A second involves questions about ecological and technological constraints to raising agricultural production and productivity in order to meet increasing demand. A third set of questions concerns the socio-economic organisation of production, including the 'optimal' use of capital and labour in order to achieve 'viable' units of agricultural production and to satisfy national goals of accumulation and distribution. In the following sections I briefly consider each of these sets of questions within the current context of Mozambican agriculture.

### **3. Value chains: the dynamics of existing markets.**

I suggested above that, while it is logical to use 'development corridors' as the location of growing demand and hence as target areas for support for agricultural development, more attention needs to be devoted to understanding the functioning and trajectories of actually-existing markets. In order to achieve such an understanding, there needs to be a willingness to move analysis beyond a statement about what is 'lacking' (infrastructure, credit, market information etc) in the present context (or, as is frequent in Mozambican policy documents, to re-create historical patterns of production and consumption), to identifying what factors drive the existing patterns of market transactions. This demands, firstly, moving beyond quantitative assessment of what is 'lacking' to identifying qualitative shifts in both the context and the potential strategies that might deliver policy goals. For example: if poor transport infrastructure is primarily a barrier to trade between 'development corridors', is this more easily remedied by improved roads, or by alternative forms of transport (e.g. coastal shipping). Secondly, it means beginning a diagnostic of agriculture not with the problems of low productivity among small-scale producers but with a more empirically-informed analysis of demand for agricultural products in particular regions, how this is changing, and what opportunities exist for smaller-scale producers to gain access to these evolving markets. In terms of 'value chains', it needs to be clear that such an approach requires an analysis not merely of 'technical' aspects (e.g. 'quality control') of production and transformation of particular agricultural products, but also an empirical analysis of the structure of the market in terms of relations of exchange, or 'terms of trade', between specific participants (producers, traders, industrial processors, retailers etc) in the value chain.

The key long-term drivers of agricultural productivity are growth in food demand in urbanising and industrialising areas. In Mozambique the historic source of such growing demand has been the capital Maputo and the southern region, together with established export markets for cotton, tobacco and cashew. However, the transport links connecting northern and central regions that produce 95% of the rice and 90% of the maize grown in Mozambique to the market in the south are expensive, and it is often cheaper to import food from South Africa to Maputo than to transport basic staples from the north. This has the effect of depressing agricultural prices in the northern region. Two factors have in recent years offered prospects of change. Firstly, a reversal since 2008 of a previous trend of falling international agricultural commodity prices during three decades has meant both higher prices for agricultural exports and also increased costs of agricultural imports and improved opportunities for import-substitution by local producers. Secondly, the major mineral extraction and infrastructural development planned for the Nacala Corridor mean an increasing demand for food located much closer to areas of relatively high potential agricultural productivity. Mosca and Selemane (2012) observe that much of the food used by company canteens in the expanding coal mining operations in Tete is imported from South Africa while local horticultural production fails to find a market. This nonetheless represents a concrete opportunity for import-substitution by Mozambican producers and traders, and a possible target of government support. More generally, these developments should raise questions as to whether agricultural markets in northern Mozambique need to be understood in terms of regional and international factors, rather than simply in terms of supplying Maputo

and the south of the country. An initial example<sup>1</sup> is provided by evidence of import substitution through the development of soya production to supply animal feed.

A domestic market for soyabean has arisen since government regulation of chicken imports in 2006, stipulating an 80-day limit on sale of imports from day of slaughter, and applying import taxes. As a consequence, the Mozambican poultry industry, which had been unable to compete with imports and had been using only 10 percent of its existing productive capacity in 2005, has increased production by about 20 percent per year over the past five years, and new investment has expanded productive capacity. As a consequence, growth in demand for soya for poultry feed, coupled with increasing international market prices for soya since 2007, has generated strong demand for locally-grown soyabean. Soya cake (80% by weight of soyabean, the remaining 20% being extracted oil) imported in 2011 was costing US\$600 /ton (20MT/kg) in Nampula, compared to about 18MT/kg for Soya beans purchased in upper Zambezia. This represents a price of about 12-13 MT to the producer. Technoserve (2011) estimated national demand for soya cake by the poultry industry in 2010 at 42 000 tons. Of this, 7000 tons is used by poultry producers in the Nampula area, 10 000 tons in the central region, and 25 000 tons in the south (mostly in Maputo). Current soyabean production in the north, centred mainly on upper Zambezia (Gurue, Lioma) and western Nampula Province (Malema, Mutuali), is likely to meet the current needs of the poultry industry (2 large-scale producers and one large 'outgrower' scheme) located around the city of Nampula. By 2014, increased demand for poultry ration in the north and central regions will need to be met by a doubling of soya production in the northern region to 22 000 tons. A continuing deficit of some 46 000tons of soya cake in the south will be met by imports, since it is projected that any soya production in northern and central Mozambique that exceeds local demand will be exported to regional markets in Zimbabwe and Malawi. However, to the extent that production and/or transport costs for soya within Mozambique can be reduced, the national and regional market for soya can be considered very strong. This presents a specific context in which to consider how local producers can best raise productivity to meet this demand.

The case of maize presents different dynamics. According to FAO countrystat data (INE, 2011), maize imports cost US\$26 million in 2009. This translates into 858 million MT or 95 000 tons of maize purchased at 9MT/kg. The current national output of maize would have to be doubled simply to satisfy domestic market demand. In practice, as noted above, much of demand is in the south of the country, separated by high transport costs from the production potential in the centre and north. As a consequence, maize supply in northern Mozambique may often be greater than local market demand, resulting in very low prices. There are also quality barriers to the purchase of locally-grown maize by industrial milling companies. In part, this is due to poor storage conditions, leading to pest and fungal damage. However an important part is also due to the variety of maize grown by small-scale producers. Many, particularly in hotter, low altitude areas, have favoured 'flint'-type maize varieties whose small grains are harder and more resistant to insect damage. This has typically been ground manually, and more recently, by small-scale commercial grain mills installed in most villages during the past decade. Industrial millers favour a softer, 'dent'-type, maize grain typical of the varieties grown in the higher-altitude areas of southern Africa (South Africa, Zimbabwe, Malawi), which typically yields higher milling ratios (60-80%) of flour to bran compared to only 50% for flint maize. This is of less importance for small-scale mills in villages, where maize bran is sold to artisanal brewing enterprises. 'Dent' maize types are grown in higher-altitude areas of northern and central Mozambique, where 'local' maize seed is often derived from historical introductions of 'dent'-type varieties from neighbouring Malawi or Zimbabwe. There is thus immediate potential for some import-substitution through the purchase of local 'dent' maize by industrial millers in northern Mozambique. Milling companies in Nampula paid between 7 and 9MT/kg for imported maize in 2011, so this establishes a ceiling on the price at which local maize producers will have to compete. In Nampula markets maize was

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<sup>1</sup> This and other empirical examples in this section are drawn from Kaarhus and Woodhouse, 2012.

priced at 7MT/kg, and in Nacala 8MT/kg but in rural maize-producing areas prices were much lower (2 – 5 MT/kg). It would appear that with adequate quality standards (mostly through storage improvement), local maize would be competitive with imports, at least in the north and central regions of Mozambique.

High international prices have also strengthened demand for Mozambican agricultural exports, particularly in 'non-traditional' crops, such as sesame, cowpea and beans. In 2009, INE data show the value of sesame exports was higher than that of either cashew or cotton, while the value of exports of both cowpea and other beans exceeded that of groundnut.

Problems with pest damage in sesame in 2009-10 prompted some groups of farmers to switch to alternative crops (notably mung bean – *feijão holoco*) in 2010-11. Published data on bean exports suggest they were worth about US\$6.5 million in 2009, but these do not discriminate between different types of beans. In practice, exports are destined to quite distinct geographical areas according to type of bean, with foreign-based trading companies seeking to purchase direct from producers during the marketing season. Mung bean (*feijão holoco*) is produced in lower-altitude areas, and is almost entirely exported to South Asia. One trader in Nampula forecast that 20,000 tons would be marketed in Nampula in 2011. Producer prices have been in the region of 20 MT/kg, but foreign purchasers are reputed to have persuaded some producers to sell at prices considerably lower than this. Unlike mung bean, pigeon pea (*feijão boer*) and cowpea (*feijão nhemba*) have strong internal markets, selling in Nampula markets for 27MT/kg and 18MT/kg, respectively, in April 2011. For such crops, a considerable premium would be required to provide farmers with an incentive to meet higher quality standards required of export markets. This is likely to apply even more strongly in the case of *haricot*-type beans (*feijão manteiga* and variants termed *catarina* and *branco*), which are grown principally in cooler, higher-altitude areas of Niassa, Tete and Zambezia. One Portuguese company has promoted a 'contract farming' scheme for *feijão manteiga* in Alto Molocué (Zambezia), providing seed as part of a contract to purchase producers' output for export to Portugal. The scheme has suffered from competition from the domestic market, however, and has yet to reach its export target of 1000 tons per year. For example, a notional scheme price of 17 MT/kg in 2010 had been raised to 20 MT/kg in the face of competition from buyers from Maputo (*feijão manteiga* may sell for 50MT/kg in Maputo, with prices in Nampula around 30MT/kg).

Growth of non-traditional exports has been accompanied by relative decline in traditional exports from the northern region, notably cotton, over the past 4 years. Low producer prices (and instances where processing companies failed to purchase all the crop), prompted the switch of small-scale producers to alternative cash crops (notably sesame and beans). Government action has tried to create a more competitive market for cotton, first by ending in 2009 the system of local concessions that allowed cotton ginning factories monopoly rights to supply inputs and purchase the crop, and then by raising producer prices from 5 MT/kg to 8MT/kg in 2010 and 15 MT/kg in 2011.

The picture emerging from these brief examples suggests growing, and more diversified, demand for agricultural output in the north of Mozambique. Anecdotal evidence suggests increasing numbers of foreign buyers (notably from South Asia) during the harvesting season. Local trading companies based in Nampula have also established networks of local buyers in villages and localities, so that marketing opportunities for small-scale producers are arguably greater than at any time since the demise of the colonial *cantina* system (see also Tvedten et al. 2010). However, it is also clear that the 'free market' terms of trade currently leave small-scale producers at a disadvantage and vulnerable to low market prices. Traders are much better positioned, in terms of access to information, credit and transport, to take advantage of local seasonal peaks of supply, especially where large numbers of farmers have decided to grow the same cash crop. Traders' costs of switching from one agricultural commodity (e.g, from sesame to mung bean) are also considerably lower than those for producers, which similarly provides them with stronger bargaining power and potentially higher margins. In this empirical reading of the current context of agricultural

markets, the problem appears to be less that there is a generalised 'lack of market access' but that many small-scale producers have little negotiating power over the prices paid for their crops. The consequences of this change of perspective may be seen by considering the PARP proposal to revitalize of the Instituto de Cereais de Moçambique (ICM) as a strategic objective to improve post harvest storage facilities. The above account of agricultural markets raises questions about what role such an intervention would fulfil. Far from filling a 'void' in agricultural markets, it seems more likely that the ICM would be involved in competition with the traders and others who currently dominate (and benefit most from) the existing rural markets.

It seems clear that without improved prices there is little incentive for producers to increase output of certain crops (notably maize) that may be strategically important from a national perspective. Conversely, crops (e.g. mung bean) for which there is relatively little demand in Mozambique may be the subject of growing demand from international markets. An analysis of agricultural price formation (value chain analysis) is therefore a pre-requisite for policy that seeks to assist small-scale producers. In the following sections I consider two broad areas of policy that may be identified as critical for the position of small-scale producers: improving farm productivity so as to reduce costs, and (possibly) raise quality, of production; and strengthening farmer organisation so as to improve the prices they receive. It will become clear that the two aspects are often difficult to separate completely, but it is useful to adopt these starting points because productivity (technological) improvement and farmer organisation are treated as separate 'strategic objectives' within the PARP.

#### **4. Ecological and technological constraints to increasing farm productivity**

The primary cause of unproductive agriculture among small-scale producers in Mozambique is often identified (including in the PARP) as a failure to use agrochemicals and improved seed varieties. It is arguable that this reflects an analysis that is too narrow in scope, which ignores important limitations arising from climatic risk and labour availability which strongly inhibit investment in more productive technology (including agrochemical use) by small-scale producers. In this section I seek to set out a broader framing of the question of technological strategies to improve agricultural productivity. In order to do so, I consider the question of improved seeds, 'conservation agriculture' and irrigation, all areas for improvement identified in the PEDSA.

There is evidence that small-scale producers generally only use agrochemical inputs where there is a guaranteed market for the crop, but that, for many, the high cost of such inputs and the risks of crop loss due to inadequate rainfall make this an unlikely path to raise productivity and income. Similar arguments can be made with respect to the use of improved varieties of seed, particularly because local supplies of good quality seed (i.e. with reliable germination) are not yet reliable in Mozambique and seed supply remains heavily dependent on imports, varying between 4000tons in 2007 and 14000 tons in 2008, when 63% originated in North America, and 29% from the SADC region (Agrifuturo 2010).

In this regard, the organisational capacity to multiply, process and deliver good quality seed lags behind the scientific expertise to identify genetic improvements in crops. With few exceptions, crop genetic improvement in Mozambique has since the colonial period relied on introductions of varieties developed in breeding programmes elsewhere. However, technical capacity to evaluate and further modify introduced crop varieties has grown markedly in Mozambican research institutes, notably the IIAM. This has been achieved by both raising staff skills and also by more effective linkage with international plant breeding programmes coordinated by the CGIAR research centres. IIAM work has focused particularly on improving basic subsistence crops, such as maize and cassava by introducing varieties with greater disease resistance. This has not necessarily been compatible with the requirements of commercial markets, as in the case of maize noted above, since IIAM's most successful

maize varieties have been of the 'flint' type, rather than the 'dent' type preferred by the milling industry. The recent expansion of production of cash crops has been based on introduction of crop varieties from neighbouring Zimbabwe (soya) and Tanzania (sesame). The key weakness in supplying small-scale producers with improved crop varieties is the failure to develop a reliable seed multiplication system within Mozambique, with the result that seed supply is either imported or of unreliable quality (Kaarhus and Woodhouse 2012). In either case small-scale producers may be unwilling to pay for seed unless it is subsidised.

In recognition of the high cost and high risk attached to raising productivity through conventional purchased inputs of agrochemicals, many development agencies have promoted a strategy of 'conservation agriculture' (CA) which seeks to raise soil fertility through reduced tillage. This is not always associated with less use of agrochemicals (see below), but is argued to allow better water conservation within soil and hence to reduce risk by making crops more able to withstand periods without rain. However, the introduction of CA into agriculture that relies upon hand-hoe cultivation highlights that a major constraint to agricultural productivity is labour shortage. Calculations based on the most recent CAP (INE, 2011) indicate that in the northern and central provinces of Mozambique between 25 and 40 % of small-scale producers rely on hiring temporary labour to prepare land for planting their crops. In contrast, the almost complete absence of labour hire for land preparation in the southern region, where animal draught is available, underlines the significance of labour-saving and labour productivity as critical criteria for technological improvement among small-scale producers in northern Mozambique. This is particularly pertinent when considering current advocacy of CA within the PEDSA).

The three main principles of CA are: to minimise mechanical soil disturbance; to maintain permanent organic soil cover; and to diversify crop rotations. Yet, although CA is widely used in Latin America and in Asia, how these principles might be productively applied in specific African contexts is the subject of considerable controversy and continuing evaluation (Giller *et al.* 2011). Grabowski (2011) evaluated two NGO projects introducing different types of CA (involving herbicides, mulch, and/or composting) in hand-hoe systems in Angonia. Three years after the start of the projects, although farmers found CA was more drought-tolerant and better for long-term soil fertility, they did not extend the method beyond the small plots where NGOs have provided inputs. This highlights a number of difficulties with the adoption of CA identified in other parts of sub-Saharan Africa. In particular, CA adoption may be limited by shortages of capital (for herbicides and fertilizer) and labour (for composting) among small-scale producers. In Mozambique herbicides may not be available, let alone affordable. Moreover, herbicides are not well-adapted to intercrops: they are generally highly specific in their effects and therefore likely to damage one or other of the component intercrops. CA would thus involve a change from intercropping to growing crops in rotation, which has further implications for the required amount and timing of agricultural labour. Finally, the Angonia study suggests the low prices generally available for maize do not adequately compensate the cost of agrochemicals, or the labour displaced from other income-earning activity (notably dry-season irrigated crops, in the Angonia case).

These observations suggest that using CA as an approach to improving soil and water conservation in small-scale agriculture can only be based on prior adaptive research to understand the specific constraints and priorities in a particular agricultural context. This will involve not just identifying the total amount of labour required for particular farm operations, but also how technological change may redistribute labour, for example between men and women (Giller *et al.* 2011). In fact, rather than a short-term goal for small-scale farmers using hand-hoes, it seems CA is more likely to assist 'emerging farmers' for whom mechanised (tractor) cultivation is affordable, in some cases through farmers' own investment in purchase of tractors. In mechanised production, the existing CA technology for cultivation (substituting 'rippers' for disc ploughs) and weed control (herbicide applied to crops grown in rotation) would be relatively easily adapted to a system growing, for example, maize in

rotation with soya. For smaller-scale producers, dependent on hand-hoe cultivation, this adaptation is likely to be more complex, and an understanding of labour productivity and opportunity costs (including off-farm opportunities) must form the basis of any analysis.

Agricultural productivity is subject to unreliable rainfall in most of sub-Saharan Africa, even in areas with high annual average rainfall, as in most of northern Mozambique, where uncertainty of rainfall distribution is the largest single constraint and source of risk in crop production. TIA data for 2002-8 show that reasons given by farmers for crop losses are dominated by 'lack of rain'. In most of the northern provinces irrigation use is recorded as less than 5% among small-scale producers, but rises to 19% in Tete and 10% in Manica (calculations from *Censo Agro-Pecuario* 2011). It is also worth noting that 'medium scale' producers in Nampula are recorded by the CAP (INE, 2011) as just as (or more) likely to use irrigation (24%) than fertilizers (18%). These data raise questions of definitions of what is understood by 'irrigation', or even 'fertilizers'. It is also not clear that agricultural policy-makers are aware of considerable 'endogenous' investments in irrigation made by small/medium scale farmers in areas such as Angonia and Manica (Bolding *et al.* 2010). More generally, it needs to be understood that agricultural water management is an integral element of existing production systems in northern Mozambique, exemplified by intensive use of water accumulation in valley bottoms to cultivate rice in the rainy season and vegetables in the dry season.

Strategies of intensification of agriculture would need to assess the feasibility of increasing water storage to enable supplementary irrigation of a larger part of the landscape, either to enable more reliable crop germination or to protect critical stages of crop growth from mid-season droughts. Water storage in on-farm dams has long formed part of large-scale commercial agriculture in southern Africa and, indeed, in northern and central Mozambique, but its development for small-scale producers raises not only issues of finance and management of infrastructure and equipment, but also political questions about how water allocation among large numbers of producers is to be governed. It is also clear that new investment in water management infrastructure would need to be informed by studies of the functioning of existing irrigation on small to medium-scale farms. While some such studies have been undertaken recently in Mozambique (van der Zaag *et al.*, 2010), much more needs to be done to understand how irrigation fits into small- and medium-scale farming systems. In the meantime, significant investments in water storage by foreign investors, exemplified by the 60 Mm<sup>3</sup> dam constructed to irrigate the 3000ha Matanuska banana plantation in Namialo, may pre-empt public policy discussions by establishing prior exclusive private rights over important water resources.

In this section, a discussion of constraints to increasing productivity in small-scale production in northern Mozambique suggests a number of factors that may serve to guide investment to increase agricultural productivity in the '*sector familiar*'. In the first place, improvement in agricultural water management (or even recognition of its widespread significance in small-scale agriculture) is needed to address a major source of production risk. Secondly, technological change, no matter how desirable from the point of view of land productivity, must address the limitations of labour shortage and labour productivity among small-scale producers. Thirdly, considerable improvement in crop productivity may be achievable through the relatively basic technology needed for reliable systems of seed multiplication, storage and delivery (be it managed on a commercial basis or not).

## 5. The organisation of agricultural producers: scale and 'viability'

The PARP identifies as one of its 'strategic objectives': "Promover as associações e cooperativas de produtores para criar economias de escala na utilização de infra-estruturas, services e insumos". In the discussion of market dynamics above (section 3) it was observed that prevailing market conditions in northern Mozambique create strong incentives for agricultural producers to organise in order to achieve greater bargaining power. Two models of organisation are emerging. In the first, small-scale producers agree contracts to sell their harvest in return for inputs supplied on credit by the crop purchaser. This 'contract farming' model, which has been used in Mozambique with some success in the case of tobacco, less so in the case of cotton, has been proposed as a means of improving terms of small-scale producers' access to markets and input supply. It has also been proposed as a means of linking small-scale producers to infrastructural improvements associated with large-scale agricultural projects funded by foreign investors.

A second model envisages the formation of 'modern cooperatives' under new legislation that allows cooperatives greater scope for commercial activity and partnership with private enterprises. It is anticipated that cooperatives will enable small-scale producers to acquire improved storage facilities and achieve greater bargaining power in agricultural markets. The explicitly commercial goals of the 'modern cooperatives' mark a change from the 'producer associations' that resulted from a variety of NGO-led rural extension programmes during the past two decades. These associations emphasised non-profit technical (i.e. agricultural extension) advice and input supply. To an extent, therefore, 'modern cooperatives' will share membership with existing associations. However it is also clear that the stricter financial requirements of cooperative membership will make them rather less inclusive than the associations which pre-dated them. Financial pressures on cooperatives are made more acute by the unwillingness of the banking system to provide credit to support small-scale agriculture. In practice, cooperatives will need to raise their own capital to finance their marketing operations, unless they have assets against which to raise bank credit. Therefore, newly-formed cooperatives will see construction of warehouses as a priority, not only as a means to store members' output, but as a strategy to secure credit for marketing operations.

The financial environment for cooperatives raises the question of dynamics of socio-economic differentiation within the 'sector familiar', which in policy documents such as PEDSA and PARP is generally discussed as if it were a homogeneous category of agricultural units. Discussion with members of producer associations (cf Kaarhus and Woodhouse 2011) makes clear that they typically include a minority cultivating more than 10 ha and a majority cultivating less than 5 ha. The minority cultivating larger areas – frequently among the leaders of the association - perceive opportunities for advancing their own particular farming enterprises as being enhanced by a supportive cooperative organisation capable of generating capital and investing it in infrastructure and equipment (especially for mechanisation of cultivation and crop processing). Even as this suggests 'grassroots' incentives for cooperative formation, it begs the question as to what socio-economic relationships agricultural cooperatives will foster. It is possible to envision at least two quite distinct outcomes. In the first, cooperatives provide a means for collective increase in scale of production and division of labour. In this model, individual cooperative members would earn wages for their work on collectively-owned large-scale production units. In a second model, the cooperative would be a means for medium-scale entrepreneurial farmers to obtain services (input supply, farm mechanisation, marketing) more cheaply than if they were acting individually.

In the 'contract farming' model, too, as exemplified by programmes to develop soya production in northern Mozambique, there is evidence of increasing focus on fewer, larger-scale (>10 ha), 'emerging' farmers capable of supporting the cost of conventional mechanised cultivation. Indeed, Oya (2012 p26) notes instances where contract farming has

been used elsewhere in sub-Saharan Africa to promote the emergence of medium-scale capitalist farmers. The question of an appropriate scale on which to organise productive agriculture in southern Africa remains open, not least in the light of the evolving experience of land reform in Zimbabwe and South Africa. In the former, a majority of large-scale capitalist farms have been subdivided to recalibrate (though not eliminate) a 'dualist' pattern of agricultural production, whose dynamics of accumulation and distribution are still evolving (Scoones et al, 2010). In South Africa, processes of land restitution to communities dispossessed during apartheid has also seen large areas of land under capitalist agriculture pass into the ownership by community trusts. A pattern of financial failure of such agricultural enterprises after land reform in South Africa has given rise to a search for new structures of agriculture, notably 'joint ventures' whereby community trusts lease land to an agricultural operating company which may be a commercial company or may itself be a partnership between the community and a commercial partner.

The operation of such 'joint venture' agricultural enterprises is fraught with hazards and it is too early to draw conclusions as to whether this provides an effective way of reconciling the political need for broad-based control of land with achievement of high productivity through capital and technological investment and economies of scale. This picture is further complicated by emerging evidence that the labour on many 'joint venture' agricultural enterprises is largely supplied from neighbouring Zimbabwe and Mozambique via intermediaries known as labour contractors. Nonetheless such arrangements illustrate an enduring tension between processes of accumulation and distribution in African agriculture in general, and not least in Mozambique, where questions of the impact of foreign investment in agriculture loom large in agricultural practice (if not in government policy documents). These considerations underline again the importance of locating strategies of agricultural development within a broader vision of social transformation in rural areas.

## **6. Conclusions**

In this paper I have observed that the PARP and its accompanying PEDSA characterise the problems of low productivity as arising from 'deficiencies', or a lack of the conditions required (technology, access to markets, storage infrastructure, producer organisations etc). Drawing on a study of production and market conditions in northern Mozambique, I have argued that, when examined empirically, these suggest a more dynamic picture of strengthening demand for agricultural output and more 'market access' among small-scale producers than the PARP suggests. In this context, conditions of poverty appear maintained and deepened by relations such as those between employers and sellers of agricultural labour, buyers and sellers of agricultural goods, between those with greater or lesser access to financial assets, and, not least, between small-scale producers and the large-scale agricultural units currently being promoted by government policy. Although this revised picture cautions against simplistic expectations of what may be achieved, it also highlights the highly political (rather than technocratic) nature of the challenge confronting agricultural policy. In the meantime, the strengthening demand for agricultural goods in local and international markets is attracting new investors in agriculture and intensifying competition for control of land and water. If the PARP is to direct its efforts towards the goal of reducing rural poverty, then it will need to be grounded in a clearer analysis of the political and economic context of the 'sector familiar' and the ways these define the technological and organisational options for agricultural development.

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