

IMPROVING THE ACCESS OF SMALL FARMERS IN EASTERN AND SOUTHERN AFRICA TO GLOBAL PIGEONPEA MARKETS

Richard Jones, H. Ade Freeman and Gabriele Lo Monaco

Abstract

The agricultural sector dominates the economies of most countries in sub-Saharan Africa, providing food, employment, income and foreign exchange. Recent developments in Africa highlight an increasing trend toward liberalised domestic markets and an opening up of their economies to the forces of international trade.

To take advantage of these developments, smallholder farmers must be able to participate in productive activities in which they have a competitive advantage. This implies access to well-organised marketing, distribution and post-harvest systems; effective market information; and technologies that allow them to be price and quality competitive.

This paper describes an ongoing strategic partnership between ICRISAT, an international agricultural research institute, and TechnoServe Inc., an international non-profit business development organisation, and their work with a range of public and private sector actors to improve the incentives for smallholder farmers to produce high-quality pigeonpeas targeted at high-value niche markets differentiated by quality standards. Examples are presented from Malawi, Tanzania, Kenya and Mozambique, where smallholder farmers are being linked to different niche markets through a range of institutional and market arrangements.

The paper concludes that a regional strategy to introduce new technologies, along with simple and easily administered quality standards based on end-user needs, can help farmers, traders and exporters to benefit from niche markets that demand higher quality standards than the traditional export market for fair average quality (FAQ) grain.

Research findings

- *There is effective market demand for both whole pigeonpeas and a range of processed pigeonpea products from eastern and southern Africa in several global markets.*
- *Improved short-, medium- and long-duration pigeonpea varieties are acceptable to farmers and different end users in eastern and southern Africa.*
- *Demand-led initiatives linked to market development or expansion are more efficient in stimulating adoption of improved technologies than those that are supply driven.*

Policy implications

- *Public sector investments are needed to undertake detailed market research to identify promising marketing opportunities for smallholder farmers.*
- *Strategic partnerships between the private sector and institutions involved in technology development and technology promotion are necessary to stimulate farmer demand for new technologies.*
- *Agencies providing support to rural communities must not undermine commercial initiatives.*
- *National governments and regional institutions need to play a more proactive role in designing market arrangements that reduce transaction costs for private sector traders and exporters.*

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CONTENTS

	Page
Abstract	i
Contact details	i
Acknowledgements	ii
1 INTRODUCTION	1
2 CHANGES IN AGRICULTURAL POLICY	1
3 THE PIGEONPEA SUB-SECTOR	2
4 TRADE AND MARKETING	3
5 PARTNERSHIPS LINKING AGRICULTURAL RESEARCH AND MARKETS	5
Working with commercial cotton companies in Mozambique	
Improving market organisation in Tanzania	
Collaborating with the private sector in Malawi to improve seed supply	
Working with horticultural exporters in Kenya to target new markets	
6 ADDRESSING SEED SUPPLY ISSUES	9
7 WHERE NEXT?	10
8 CONCLUSIONS	10
REFERENCES	11
ENDNOTES	11

Tables and figures

Table 1	Pigeonpea duration groups, growth habit, and days to maturity	2
Table 2	Economically important insect pests of pigeonpea in eastern and southern Africa, damage symptoms, and level of losses caused	3
Table 3	Average production and area of pigeonpeas in Kenya, Malawi, Tanzania and Uganda 1980–2 and 1995–7; and annual growth rate in production 1980–97	3
Table 4	Marketing margins (%) in selected alternative channels for pigeonpea in Kenya	4
Table 5	Tanzania, a comparison of traditional markets and premium export markets	8
Figure 1	Indian imports of unprocessed pigeonpeas	4

Acronyms

DARTS	Department of Agricultural Research and Technical Services (Malawi)
FAO	Food and Agriculture Organization
FAQ	Fair Average Quality
GALDAL	Grain and Legumes Development Association Limited
GDP	Gross Domestic Product
ICRISAT	International Crops Research Institute for the Semi Arid Tropics
INIA	<i>Instituto Nacional de Investigação Agronómica</i> (Mozambique)
NARES	National Agricultural Research and Extension Systems

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1 INTRODUCTION

The agricultural sector is the mainstay of many economies in sub-Saharan Africa, contributing about 18% of GDP, 23% of the total value of exports, and employing 69% of the active labour force (World Bank, 1999)¹. The sector is an important source of raw materials for industry, as well as providing food, employment, income and foreign exchange. Agriculture's central economic role makes its further development and growth an essential component for overall economic growth and the wellbeing of the population, the majority of whom live in rural areas.

In much of eastern and southern African agriculture there is a distinct division into the smallholder sector and the large-scale sector, although the balance between the two varies significantly from country to country. Before independence, agricultural production of traditional export crops (including coffee, tea and cotton) from the smallholder sector boomed as a result of increased producer share in export prices and access to markets. However, growth in this sector was depressed in the post-independence period due to government economic policies imposing direct and indirect taxes that discriminated against the agricultural sector, reducing economic incentives for agricultural producers.

Aggravating this situation, public revenues from agricultural taxes were for the most part invested in industries unrelated to village agriculture and rural industries, and thus did not directly contribute to growth in the sector (Lin, 1998). The cumulative effect of government economic policies was a gradual loss of export market shares in world markets. For example, the share of sub-Saharan Africa in the total value of agricultural exports from developing countries declined from 28% in 1961–3, to 12% in 1995–7 (FAO, 1998). Thus, an important policy issue facing policymakers in Africa is how to improve the region's competitive advantage in international markets in order to regain lost export market shares.

Recent developments in Africa highlight an increasing trend toward liberalised domestic markets and an opening up of their economies to the forces of international trade. In particular, there is an increased trend toward outward-oriented policies, with export markets seen as important sources of economic growth. These trends provide new opportunities and challenges for poor smallholder farmers in developing countries. However, to take advantage of these opportunities smallholder farmers must be able to participate in

productive activities in which they have a competitive advantage. This implies access to well-organised marketing, distribution and post-harvest systems; effective market information; and technologies that allow them to be price- and quality- competitive.

Unfortunately, the long-term marginalisation of agriculture in Africa since independence has left the sector fragmented, and poorly equipped to take advantage of recent policy reforms that would permit efficient use of international competitiveness. Smallholder farmers face high transaction costs and uncertainty arising from missing or incomplete input and product markets, high access barriers and costs of information, and other market imperfections that restrict market access. Policymakers face the challenge of determining and fostering the most productive roles for public, private, and non-governmental organisations in supporting African farmers, traders and agribusinesses (Eicher, 1999). Only working together can these actors establish the institutional relationships that can provide and facilitate access to technology, information, capital and marketing arrangements – all necessary for developing a competitive advantage in international markets.

This paper highlights key issues related to the impact of globalisation on smallholder farmers in eastern and southern Africa, and then outlines how a market-based approach has been used to improve the competitive advantage of smallholder farmers growing pigeonpeas (*Cajanus cajan*). The paper concludes by examining the implications for agricultural research of supporting a market-based approach to development.

2 CHANGES IN AGRICULTURAL POLICY

In the post-independence period, governments throughout eastern and southern Africa were quick to recognise the political importance of ensuring a reliable and affordable supply of food to urban consumers, and implemented a range of policies to ensure that this was achieved. The focus was on national food security, which for the most part was interpreted to mean national self-sufficiency in maize, the dominant staple of the region. The policy interventions pursued to achieve this objective included the regulation of input and/or output markets, and the provision of subsidised credit, seed and fertiliser. These policies did not have a direct impact on the pigeonpea sub-sector which was not regulated. However controls on foreign exchange transactions resulted in discrimination against all agricultural exports

including pigeonpea. In the early 1990s many countries in southern and eastern Africa embarked upon a process of economic structural adjustment resulting in the liberalisation of input and/or output markets, the removal of subsidies, and the elimination of foreign exchange controls. The move towards market exchange rates raised domestic producer prices for export crops, which provided additional incentives for producers. The liberalisation of domestic agricultural markets and the effects of globalisation provided new opportunities that could benefit poor farmers, but for this to happen priority needs to be given to interventions that improve the competitiveness of smallholder farmers (IFAD, 2001).

The application of the sustainable livelihoods approach has exposed and unravelled the complexity of rural livelihoods (Carney, 1999), and moved thinking about food security beyond just food-first. A more balanced approach to agriculture is now being advocated which includes the need not only to promote food crops, but also cash crops to generate income that can be used to purchase food. Unfortunately past legacies have meant that few smallholder farmers have actually benefited from globalisation. The problem is particularly acute in low-potential areas where soils are impoverished, rainfall low and erratic, and where the majority of the rural poor live (see Maxwell, 2001). The research question examined in this paper is how can smallholder farmers be integrated into high-value markets through interventions that increase productivity, reduce transaction costs and improve market access? This paper will attempt to answer some of these questions using pigeonpea as an example. This example is instructive because pigeonpea is a crop that is both well adapted to the needs of poor smallholder farmers in the semi-arid tropics, and has an export demand.

3 THE PIGEONPEA SUB-SECTOR

Pigeonpea is a legume cultivated in the tropics and sub-tropics. The crop thrives in hot dry environments, its drought tolerance and ability to utilise residual moisture during the dry season making it important in the semi-arid tropics. The crop not only produces edible peas that can be consumed both fresh and dry and nutritious fodder for livestock, its woody stems can be used as fuelwood. Most importantly for poor smallholder farmers in eastern and southern Africa is the crop's ability to fix atmospheric nitrogen (N) and make iron-bound phosphorous (P) soluble which not only satisfies the pigeonpeas' own nutrient requirements, but also benefits subsequent crops. N and P deficiencies are widespread throughout the region, and are a major constraint to crop production.

Pigeonpeas have been classified into three major duration groups (see Table 1).

Traditional pigeonpea landraces are indeterminate long-duration types well adapted to the farming systems where they are grown. Smallholder farmers invariably intercrop pigeonpeas with cereals, establishing both crops together at the beginning of the rainy season. The earlier-maturing cereal is harvested at the end of the rainy season, leaving the longer-maturing pigeonpeas to develop fully on residual moisture several

months later. The slow-growing pigeonpea does not compete with faster-growing cereals, and because of its deep rooting system is able to continue growing well into the long dry season when the land would otherwise be unoccupied. The close adaptation of the crop to the growing environment that results from its sensitivity to both day length and temperature is something of a double-edged sword as locally adapted materials are not easily transferred to different agro-ecologies. For example, in areas where the rainy season is very short, long-duration pigeonpeas can exhaust soil moisture reserves before the crop matures, and in areas where there is little variation in temperature or day length the crop will often not flower after 12 months or more. Once the phenology of the crop was understood (see Silim et al., 1994), it became possible to develop earlier-maturing varieties with determinate growth habits, relatively insensitive to day length and temperature. Although this has made the movement of the crop into non-traditional growing areas much easier, there are problems associated with increased pest attack.

Like other legumes, pigeonpea is susceptible to damage from insect pests which occurs mainly during the flowering and podding stages in the field, and later in storage. More than 200 species of insects have been recorded on pigeonpea, but only a few cause economic losses and are common in large areas. The economically important insect pests of pigeonpea in southern and eastern Africa, and the damage they cause are described in Table 2.

Of primary importance are weevils, predominantly *Callosbruchus chinensis*, which can penetrate the pigeonpea pods and infest the grain in the field before harvest. At the farm level there is very little inter-seasonal storage of pigeonpea due to the possibility of substantial damage during storage. Rural assemblers store the dry grain in sacks in unimproved facilities for even shorter periods than farmers, moving it within two to three days. They rarely treat or store it for longer than this because of a lack of good storage facilities and the cost of storage chemicals. Likewise, the majority of rural wholesalers move pigeonpea grain within short periods of time (less than a week) even though most of them have good storage facilities. Again the most important reasons cited are the cost of storage chemicals and the risk of grain loss due to infestation by storage pests, which reduces the quality and market value of the grain. Larger traders, who export the whole grain, have better storage facilities and the technical expertise to fumigate the stored product.

Research investments in pigeonpea by ICRISAT, which has the global pigeonpea mandate, and its partners in many different national agricultural research

Table 1 Pigeonpea duration groups, growth habit, and days to maturity

Duration group	Growth habit	Approximate days to maturity
1. Short-duration	Determinate	100-120
2. Medium-duration	Indeterminate	150-200
3. Long-duration	Indeterminate	>220

systems around the world have been successful in both increasing productivity and fitting the crop to new environments where it was previously unknown. Unique among the legumes, the first hybrid pigeonpea has recently been developed, and preliminary results suggest that yield increases of more than 30% result from heterosis (Saxena et al., 1996). The importance of these investments in creating new marketing opportunities for the crop will be expanded upon later in this paper.

4 TRADE AND MARKETING

Pigeonpea is widely grown by smallholder farmers in eastern and southern Africa (Table 3) both for subsistence and as a cash crop². At the household level it is consumed as a green vegetable, cooked whole, as well as in dhal³ form. It is particularly important in local diets in eastern Kenya, southern Malawi, northern Mozambique, southern Tanzania and northern Uganda where it is the legume of choice grown by local populations because of its adaptation to the agro-ecology of these areas. In Kenya there is a significant domestic demand both for dhal from the ethnic Asian community and for whole pigeonpeas from the Kikuyu and Swahili communities who eat it on special occasions. None of these groups is a major producer of the crop, with the result that there is a significant domestic and regional trade in whole pigeonpeas, and a local industry for processing them into dhal.

Pigeonpea production in Kenya is primarily concentrated in the semi-arid districts making up Eastern Province. Although pigeonpeas are extremely drought-resistant, surplus production from these areas is very

much dependent on there being sufficient rainfall to see the crop through to maturity. When there is a production shortfall, Kenyan traders travel to Babati District in northern Tanzania to purchase whole pigeonpeas from rural assemblers. These are processed into dhal by Kenyan millers both for domestic and export markets as Tanzania does not yet have a domestic processing industry. The removal of tariffs on agricultural produce traded between Kenya, Tanzania, and Uganda by the East African Community is likely to encourage increased cross-border trade. Similar cross-border trade in pigeonpeas takes place from northern Mozambique into Malawi which has the largest installed pigeonpea processing capacity outside of India (Ackello-Ogutu and Echessah, 1997). However, in Malawi's case, virtually all the crop is exported either as whole pigeonpeas or processed dhal. This trade was undoubtedly stimulated by the protracted civil war in Mozambique which severely restricted movements within the country. Now the war is ended, Mozambican traders and entrepreneurs are becoming actively involved in the export of the crop direct from the deep-water port at Nacala.

Traditional marketing channels have high marketing and distribution costs, as the crop passes through several intermediaries with little value being added before reaching the end-users. Typically rural assemblers bulk the crop and sell it to middlemen/traders in local market centres. The crop is then taken to larger produce markets where it is sold to transporters who deliver it to processors and exporters. Table 4 shows marketing margins based on buying and selling prices for selected marketing chains. These are gross marketing margins

Table 2 Economically important insect pests of pigeonpea in eastern and southern Africa, damage symptoms, and level of losses caused

Insect type	Symptoms	Level of losses
Pod-boring Lepidoptera	Larvae bore a hole into the green pod and then proceed to eat the maturing seeds.	Total loss
Pod-sucking Hemiptera	Adults and nymphs pierce through the wall of the green pod and suck the juice from the immature seeds causing them to shrivel.	Reduced quantity and quality; total loss
Seed-boring Diptera	Maggots (larvae) eat the immature seeds.	Total loss
Storage Coleoptera	Beetles lay eggs on the seeds, which hatch into larvae. The larvae bore into the seed where they feed.	Reduced quantity and quality

Table 3 Average production and area of pigeonpeas in Kenya, Malawi, Tanzania and Uganda 1980–2 and 1995–7; and annual growth rate in production 1980–97

Country	Production (mt) Average 1980–2	Production (mt) Average 1995–7	Area (ha) Average 1980–2	Area (ha) Average 1995–7	Annual growth rate in production (1980–97)
Kenya	28,845	44,874	66,337	147,510	4.7
Malawi	85,000	98,000	127,333	143,000	0.8
Tanzania	22,667	37,333	36,667	56,667	2.2
Uganda	26,333	58,333	55,000	71,000	6.1

Source: Freeman et al., 1998

because the nature of some of the marketing systems – including both cash costs and implicit costs – makes it difficult to estimate marketing costs precisely.

The analysis indicates that the gross marketing margin in the complete distribution chain is highest for urban retail of dhal followed by retail of dried pigeonpeas in supermarkets. In both marketing channels farmers receive the lowest share of final consumer prices while urban processors receive the highest. It is difficult to determine whether these margins reflect traders' profits or point to inefficiencies in the marketing system without complete knowledge of marketing costs (transport, storage, processing), other transaction costs, and marketing risks. Nonetheless, the very large price spread between producers and consumers in these channels suggests that there may be opportunities for transferring a proportion of the margins to benefit the producers (Freeman et al., 1999).

Although there is both a domestic and regional trade in pigeonpea in eastern and southern Africa, what makes pigeonpea different from other food crops such as maize is the export trade to India and other overseas markets. India is the world's leading producer as well as major consumer of pigeonpeas, nearly all of which are processed into dhal, which is prepared into a thick soup for mixing with rice. The latest data available indicate that domestic consumption of pigeonpea reached two million metric tonnes (mt) in 1996/7. For a long time, India has imported whole pigeonpeas to make up for shortfalls in domestic production. Figure 1 shows the size of this demand which fluctuates from year to year, depending largely on domestic production.

It is largely in response to the demand from India that the trade in whole pigeonpeas from Kenya, Malawi, Mozambique and Tanzania has developed. The figures in Table 3 show that there was a major expansion in production between the early 1980s and the mid-1990s. This can be attributed to the additional incentives for producers resulting from the move towards market rates of exchange occurring in the early 1990s. However, the increased production was the result of an area expansion rather than any increased productivity, as smallholder farmers continued to plant low-yielding local landraces with minimal use of purchased inputs throughout this time. These varieties are harvested in August/September and exported in unprocessed form as fair average quality (FAQ) grain. The Indian market

Figure 1 Indian imports of unprocessed pigeonpeas

Source: Indian Foreign Trade Statistics

is not very discriminating in terms of quality, and FAQ grain can contain up to 7% of weeviled and damaged grain and foreign matter (Jaeger, 1998).

Due to the unreliability of national statistics it is difficult to document accurately the development of the pigeonpea trade between eastern and southern Africa and India. Discussions with key informants suggest that it has been exported continuously at least since the early 1970s. The presence in eastern and southern Africa of ethnic Indian communities familiar with the crop, and with established contacts in India, was undoubtedly a major factor.

Several other factors contrived to make pigeonpea an attractive export crop for eastern and southern Africa. First, unlike maize, there have never been any government price controls or export bans on pigeonpea because the crop was never considered strategically important for national food security. Second, the African harvest takes place slightly before the main Indian harvest, so traders could take advantage of higher prices at the end of the Indian season. Third, pigeonpea productivity in India has not kept pace with population increase because farmers in high-potential areas have switched to growing more input-responsive crops, marginalising pigeonpea production to less favoured environments. Finally, during the era of over-valued

Table 4 Marketing margins (%) in selected alternative channels for pigeonpea in Kenya

Marketing chain participant	Urban retail (supermarket)	Urban retail (open-air market)	Urban retail of dhal	Export of whole grain
Rural assembler	6	8.4	8.1	3.3
Rural wholesaler	3	5.2	4.3	1.7
Urban transporter	5.3	24.4	7	2.9
Urban processor/exporter	31.4	-	41.9	60.3
Urban retailer	25.7	20	-	15.9
Complete distribution chain	71.4	58	61.2	84.1
Producer share	28.6	42	38.8	15.9

Source: Freeman et al., 1999

currencies before structural adjustment policies were introduced in the early 1990s, the ready availability of pigeonpeas for export from eastern and southern Africa in exchange for hard currency provided traders with a lucrative opportunity to earn foreign exchange.

An interesting feature of the Indian market was the prohibition by the Indian government on the export of dhal, while at the same time levying an import tariff of 35% on imports to protect the domestic processing industry. Although this import duty made it unattractive for African dhal processors to export to India, it provided an opportunity for the very same processors to export dhal to ethnic markets around the world. As a result, a thriving pigeonpea processing industry developed in Kenya and Malawi.

Although India's pigeonpea deficit is projected to continue to grow (Jaeger, 1998), a number of challenges have emerged that threaten the long-term viability of the pigeonpea sub-sector in eastern and southern Africa. This has important implications for smallholder farmers with few cash crop alternatives to pigeonpeas. First, Myanmar has become a major exporter of whole pigeonpeas to India and there is growing evidence that it can do so at lower cost than countries in eastern and southern Africa (Lo Monaco, 2001). Second, India itself has not been unaffected by the forces of globalisation, and has not only removed the export ban on dhal, but actually provides tax incentives to exporters that are not available to Kenyan and Malawian processors, making it harder for them to compete in international markets. Third, several countries including the US, Canada, France and Australia have identified the opportunity to export non-traditional legumes to India including chickpeas, yellow peas and pigeonpeas⁴. Up to 300,000 metric tonnes of yellow peas are imported annually from Canada and France. In September 2001, these were available at US\$200/mt compared with \$300/mt for pigeonpeas ex-Myanmar, and \$315/mt ex-Tanzania. Although Indian consumers have definite taste preferences in legumes, they are not price-insensitive and will switch to alternative pulses if the price is right.

For countries in eastern and southern Africa to remain competitive, productivity needs to increase, transaction costs have to be reduced, and quality standards improved. High transport costs are of particular concern to landlocked Malawi where the cost of sending a fully loaded 20-foot container to Mumbai is \$1800 compared to \$800–1200 for Tanzania, and \$500–800 for Kenya. Transport costs from Myanmar to India are similar to those for Kenya, while improvements in transport infrastructure in Mozambique have reduced costs to below those of Kenya.

Differences in cost structure and competitiveness among pigeonpea exporters provide considerable challenges for the long-term viability of the sector. What needs to be done by regional organisations, national governments, the private sector, agricultural researchers and extension workers in response to these challenges? Clearly there needs to be greater collaboration between the various stakeholders, but the experience to date has been of the different actors operating independently of each other. Agricultural researchers and extension

staff have been slow to interact with the private sector, and as a result neither producers nor the private sector have benefited greatly from investments in technology development. On the other hand, agricultural researchers have responded to charges that many of the technologies they have developed are irrelevant to the needs of smallholder farmers which has led to closer farmer involvement in technology development.

A central argument in this paper is that agricultural researchers and extension workers need to think beyond the farm gate and develop strategic partnerships with market players and policymakers to effect real change. The next part of this paper describes one type of partnership required to bring about change, based on experiences from the pigeonpea sub-sector by ICRISAT and other partners.

5 PARTNERSHIPS LINKING AGRICULTURAL RESEARCH AND MARKETS

The comparative advantage of an international agricultural research centre such as ICRISAT lies in its collaborative work with national agricultural research and extension systems (NARES) on technology development and dissemination. Significant progress has been made in the development of pigeonpea technologies attractive both to farmers and private-sector traders and processors.

First, traditional long-duration pigeonpea landraces have been identified and screened for resistance to fusarium wilt. This soil-borne disease blocks the xylem vessels that transport water from the roots to the leaves, causing the plant to wilt and die. In severely infected fields, 100% mortality can occur. An impact assessment of fusarium wilt resistance in India found that the total net present value of benefits from collaborative fusarium wilt research is approximately \$62 million, representing an internal rate of return of 65% (Bantilan and Joshi, 1996).

In Malawi, the fusarium wilt-resistant variety ICP 9145 was hurriedly released in 1987 after a severe outbreak of the disease resulted in widespread crop failure. Although ICP 9145 was wilt-resistant, it was not popular with Malawian traders and processors because of its relatively small seeds and tight seed coat which reduces the percentage recovery of dhal from whole grain to about 70%. Processors typically prefer bold cream-coloured pigeonpeas because the bold split cotyledons attract a premium price, and small pieces of seed coat left after the dehulling operation do not reduce the price premium if their colour blends in with the yellow cotyledons. Farmers also mentioned that ICP 9145 took a long time to cook, a function of the tight seed coat disliked by processors. In response to these shortcomings, ICEAP 00040 was selected after extensive testing both with farmers and industry players, and has been released in Kenya, Malawi, and Tanzania. This variety combines fusarium wilt resistance, bold cream-coloured seeds, a fast cooking time and is easily dehulled. Although indeterminate long-duration varieties like ICEAP 00040 are well adapted to the intercropping systems widely practised by smallholder

farmers, the fact that they take approximately 10 months to mature and are only available from August because of their daylight and temperature sensitivity reduces the traders' flexibility. Determinate short-duration varieties have been bred which mature in just over three months, permitting the crop to be grown in areas not suitable for the long-duration types, and allowing multiple harvests through repeated sowings. Unfortunately short-duration varieties are much more susceptible to insect pest attack, necessitating the use of insecticides to achieve an economic return. Research efforts are underway to develop varieties more resistant to pest attack and also to develop integrated pest management strategies. If insect pests are controlled, short-duration varieties are significantly higher-yielding than the long-duration types because it is possible to harvest two or three times in the same period. The recent breakthrough in developing the world's first legume hybrid promises to deliver the very significant yield gains required for pigeonpeas to remain competitive with other pulses. The application of biotechnology to conventional plant breeding will reduce the development time from inception to product release and will allow the products of breeding programmes to be more closely tailored to end-user needs.

In an emerging market economy, the real test of successful technological innovation is not in the test plot or the laboratory, but in the marketplace, which includes the range of actors within the broad web of input supply, production, harvest, storage, processing and marketing. The ability of agricultural research alone to create adequate incentives to spur the adoption of technological innovation is limited. And yet, the adoption of technological innovation is essential for future growth and development. A major challenge is how to create the necessary institutional arrangements to stimulate adoption of these new technologies by producers. For example, the development of varieties with the improved grain quality desired by processors will be of little interest to farmers unless there is a financial incentive for them to grow these varieties. Why grow short-duration pigeonpeas requiring the use of expensive pesticides when traditional long-duration varieties can be successfully grown without substantial investments in pest control? The fact that farmers do not always adopt seemingly attractive agricultural technologies can in many cases be attributed to there being no financial incentive or support structure for them to do so. Neither ICRISAT nor its NARES partners have comparative advantage in markets or business development, but they can catalyse the development of partnerships to create the necessary incentives, thereby stimulating demand for new technologies. This is very different from the traditional supply-side approach to technology dissemination which has had such limited impact in increasing agricultural productivity.

The importance of pigeonpea markets has already been touched upon. This limited understanding was achieved through discussions with market actors by ICRISAT working together with its NARES partners, but

clearly it was important to have a more detailed understanding of the complete marketing chain before interventions could be considered. TechnoServe Inc., a US-based not-for-profit organisation with country offices in Kenya, Mozambique and Tanzania had independently identified pigeonpea as a crop of significant potential. During discussions it was realised that they shared the goal of improving the competitive advantage of farmers by helping them to gain access to the products of research that would satisfy the demands of high-value niche markets for pigeonpea. It was agreed that the starting point for collaboration with TechnoServe would be a detailed sub-sector analysis within each of the four major pigeonpea-producing countries in eastern and southern Africa. With the information generated from these studies, leveraged interventions could be designed and implemented to overcome the identified constraints. An added benefit from the collaboration was the fact that TechnoServe specialises in enterprise development based on the philosophy that economically viable businesses will create income and economic growth for producers. Not only would such a partnership help in developing a more detailed understanding of the pigeonpea sub-sector, it would also assist in strengthening private-sector collaborators capable of stimulating demand for pigeonpea technologies. The rest of this paper will be used to describe how this strategy is evolving in different countries of eastern and southern Africa.

Working with commercial cotton companies in Mozambique

In 1998 the TechnoServe office in Mozambique identified pigeonpeas as one of six commodities with significant promise for business development in that country. Prior to the protracted civil war that ended in 1992, Mozambique had been a major exporter of whole pigeonpeas, mainly to India. Although farmers continued to grow the crop throughout the war formal exports were disrupted, and instead the crop found its way to neighbouring Malawi through informal cross-border trade (Ackello-Ogututu and Echessah, 1997).

An examination of price trends in the Indian market by TechnoServe suggested that if deliveries of pigeonpeas from eastern and southern Africa could be advanced to May, and a constant supply maintained until October/November, instead of the present situation where there is only an assured supply for two months from October, prices would be firmer. In addition to the price issue, Indian processors also expressed concern over the unreliability of supply from eastern and southern Africa, and the fact that production from the region comes all at one time. The message was clear: although India's pigeonpea deficit is projected to continue to grow (Jaeger, 1998), to remain competitive in this market, which is relatively undemanding in terms of quality, the amount, reliability and timing of supply had to be addressed.

ICRISAT, working with the Instituto Nacional de Investigação Agronómica (INIA), had already tested a range of improved short-, medium- and long-duration varieties and demonstrated the feasibility of extending

the production season from May to October through the introduction of short- and medium-duration varieties in addition to the traditional long-duration types already grown by farmers. A possible technological solution in the form of short- and medium-duration varieties existed to respond to the marketing opportunity identified by TechnoServe, except that a pest-control package had to accompany these varieties because of their greater susceptibility to insect pests.

Mozambique is a major producer of cotton, grown largely by smallholders and marketed to companies holding sole concessions for different geographical areas. The cotton companies provide inputs (seed and insecticides) to farmers on credit, which is then recovered when the crop is purchased back. TechnoServe developed a business plan using data from ICRISAT and INIA that demonstrated the profitability of a cotton-pigeonpea rotation, and presented this to the cotton companies. For agronomic reasons cotton cannot be grown continuously on the same piece of land, and pigeonpeas were presented as an ideal rotation crop both because of the market demand from India, and the fertility benefits resulting from residual nitrogen in the soil which would boost the yield of subsequent cotton crops. By linking with the cotton companies, farmers would be able to access insecticides through the same institutional arrangements as for cotton. The seasonal price differential that creates the incentive for this development is significant. Over the past five years the average December-to-February price, when the Indian crop hits the market, has been US\$337/mt CIF Mumbai. In July-September, the corresponding five-year average high price has been US\$465/mt, a 38% premium.

TechnoServe facilitated a visit for major Indian traders and processors to Mozambique. They met with cotton companies, farmers' associations and exporters, and were introduced to several improved pigeonpea varieties developed by ICRISAT. They identified an improved short-duration variety (ICPL 87091) as having a good taste and appropriate milling characteristics. To further enhance its profitability, a specific brand, Nacala Gold, has been developed for ICPL 87091 exports from Mozambique. In time the brand's implicit guarantee of a superior product should be able to attract an additional US\$10-25/mt (personal communication, 1999).

TechnoServe, the cotton companies, ICRISAT and other collaborators are now working to supply part of the demand for 100,000 tonnes per annum from May to September, a market that is projected to grow at 20% per annum. Seed is being multiplied and inputs supplied and financed by a range of agencies, including the cotton companies, farmers' associations and exporters.

In a related development, a new company, SAGAR Zambezia Ltd, has been established with a 60% shareholding owned by SCI of Mozambique, and 40% by SAGAR Lentils of India. The new company is planning to process pigeonpeas into dhal using machinery presently being fabricated in India which will be installed later this year in premises belonging to SCI in Gurué, Zambézia. The capacity of the factory

will be 6000 mt per annum, and the company is planning to source organically grown pigeonpeas from smallholder farmers organised into production groups for this purpose. The fact that Mozambique has large tracts of underutilised land makes it feasible to take on initiatives such as this where crop management needs to be strictly controlled to meet organic certification standards. Another factor that makes Mozambique an attractive destination is the proximity of pigeonpea-growing areas to the deep-water harbour at Nacala with regular sailings to major markets. The only reason a similar approach cannot be pursued in other countries is that they do not have the institutional arrangements found in the Mozambique cotton sub-sector.

Improving market organisation in Tanzania

TechnoServe in Tanzania took a different approach and identified interesting marketing opportunities in the European market. The principal importer and consumer of pigeonpea in Europe is the United Kingdom, owing to its large population of peoples of Indian and Caribbean descent. Imports by other European nations are negligible, other than those by Portugal to supply the Cape Verde Islands. However market research in Europe indicated a significant niche market for high-quality grain (Jaeger, 1998) with pigeonpeas grown in northern Tanzania being recognised by European buyers because of its favoured bold cream-coloured grain.

In northern Tanzania, late-maturing pigeonpeas are traditionally intercropped with maize. The majority of the crop is sold as a bulk commodity to traders who sell to exporters serving the whole grain market in India. Quantities purchased and exported are highly sensitive to pigeonpea demand in India as already described. It is not a quality-driven market – no strict grade standards are imposed – and rather high percentages of off-types and foreign matter are common.

However, an increasing amount of whole clean white, large-seeded varieties of pigeonpeas are being shipped to Europe. TechnoServe's research indicates this market is 1500-3000 tonnes annually, and growing. In contrast to Indian buyers, European importers and brokers are very quality conscious and demand strict compliance regarding seed cleanliness and breakage. A premium is paid for the pre-cleaned product, usually around US\$100/mt over the world market prices for unprocessed pigeonpeas. The final product is supplied to supermarkets as packaged dried whole pigeonpeas or to the canning industry. To meet this market's demands, traders buy FAQ grain from farmers, and then sort it by hand, capturing for themselves the price differential.

Obvious benefits to smallholders are possible if they can directly produce this higher quality product. Accordingly, TechnoServe is organising small farmers in northern Tanzania into local groups which are provided with appropriate training in village-level grain cleaning and handling. These groups are linked directly to exporters, who in turn are linked with identified European buyers. To facilitate and expand the exporters' cash purchases from these groups, TechnoServe works

with commercial banks to provide the exporters with working capital loan guarantees.

While TechnoServe was working on improving grain quality through hand-sorting, ICRISAT was cooperating with the national agricultural research and extension service to test a range of improved long-duration pigeonpea varieties with farmers. These varieties were selected for their resistance to fusarium wilt, and for their bold cream-coloured seeds. Two consecutive seasons of on-farm testing confirmed that the preferred variety, ICEAP 00040, was resistant to wilt and approximately 30% higher-yielding than existing landraces. European buyers who were sent samples, supplied by ICRISAT to TechnoServe, were also satisfied with the grain quality of this variety. Fortuitously the main exporter involved in this trade also runs a seed company, which is now multiplying seed of ICEAP 00040. Once the variety is officially released, it will be sold to farmers who will benefit in terms of increased yield. Also, provided some degree of varietal purity is maintained, ICEAP 00040 should not require the same level of hand-sorting as local landraces which tend to have more variable grain size and colour.

Early data suggest that the incremental production costs for the farmers to adopt new late-maturing varieties is small, and consists primarily of modest seed costs, possible additional insecticide application, and additional harvesting costs. However these are largely offset by savings coming from the elimination of pre-sorting by the buyers prior to selling on, the idea being that sorting and grading should rather be done on the farm. Table 5 provides a summary of the potential financial benefits to be derived from the substitution of traditional varieties with improved long-duration varieties.

Pigeonpeas have now been exported to this market for two consecutive seasons, and in 2001 farmers received a price premium of 25%.

Collaborating with the private sector in Malawi to improve seed supply

The principal supplier of dried pigeonpeas and processed dhal to the UK is Malawi which has established a reputation for superior-grade dhal. The UK imports approximately 1500 tonnes from Malawi annually. Other markets for split pigeonpeas include North America, mainly for the large Asian immigrant

population in the US and Canada. In recent years, Malawian processors have had difficulty maintaining quality standards both for whole dried pigeonpeas and processed dhal because of a limited supply of quality grain from producers. For Malawi, export of the processed product is of course attractive, as it permits capture of additional value by local agro-processors necessary to offset the higher freight as a result of being landlocked.

With the cessation of hostilities in Mozambique and the re-establishment of direct exports from that country, Malawian processors recognise that the viability of their industry was threatened because of insufficient product. There are 10 established processors in Malawi, with a combined processing capacity of 20,000 tonnes, making Malawi the second largest pigeonpea processing country in the world after India. Until the mid-1990s these companies operated as competitors, but the external threat to their industry stimulated them to consider some degree of collaboration. Up until that time, contacts between agricultural researchers and private-sector traders and processors were nonexistent, with the result that the technological improvement needs of this important group of end-users were not considered. In 1997 the Department of Agricultural Research and Technical Services (DARTS) and ICRISAT hosted a national planning workshop and invited one of the dhal millers to the meeting. As a result of this contact other industry players were informed about efforts to increase pigeonpea productivity, which led to the establishment of the Grain and Legumes Development Association Limited (GALDAL). GALDAL is a legally-registered business established for the purpose of nurturing the development of grains and legumes in Malawi, with a membership that includes eight companies involved in pigeonpea trading and processing.

The first initiative of GALDAL was to address seed supply, as the association was keen to promote the production of the improved long-duration variety ICEAP 00040 as a replacement for ICP 9145 released in 1987. This wilt-resistant variety was disliked by millers because of its small grain and tight seed coat, and as a result Malawian pigeonpeas were no longer fetching a price premium averaging around \$40/mt which the industry had been able to attract in the early 1980s. Extensive on-farm testing with smallholder farmers in

Table 5 Tanzania, a comparison of traditional markets and premium export markets¹

Production/marketing method	Yield	Selling Price \$ per kg	Gross income	Net income	Additional income
Traditional mixed varieties, sold to agents/local market	900 kg ha ⁻¹	\$0.17/kg	\$153 ha ⁻¹	\$92 ha ⁻¹	N/A
Improved white varieties, sold directly to exporter	1200 kg ha ⁻¹	\$0.21/kg	\$252 ha ⁻¹	\$191 ha ⁻¹	\$99 ha ⁻¹

¹ The implicit production cost of \$33 per hectare is derived by distributing the total per hectare production costs of \$152 between the intercropped maize and pigeonpea, based on yields.

Source: Pigeonpea sub-sector study, TechnoServe 1998

two of the major pigeonpea-growing areas by DARTS confirmed the wilt resistance of ICEAP 00040 and, importantly for farmers, the faster cooking time and higher yield of this variety. For example yields of ICP 9145 in on-farm trials averaged 100 kg/ha in 1997/8 and 165 kg/ha in 1998/9 compared with 108 kg/ha and 264 kg/ha for ICEAP 00040 over the same seasons (Ritchie et al., 2000). ICRISAT and DARTS supplied foundation seed of ICEAP 00040 to GALDAL, which then underwrote the cost of contracting farmers to multiply 100 tonnes of certified seed in 1998/9, sufficient to plant 20,000 ha in the 1999–2000 season. Government inspectors carried out seed inspection and certification, but no clear strategy was devised to market the seed to farmers. The issue that the association and its partners now face is how to stimulate farmers' demand for the improved seed. This will be expanded upon later.

Working with horticultural exporters in Kenya to target new markets

In Kenya regular exports of fresh green pigeonpeas to the UK have been documented. This trade has evolved because determinate short-duration pigeonpeas that can be harvested year-round are now available to farmers. Demographic change is creating a demand for immigrants' traditional foods in their new homes, and changing work patterns mean there is a greater demand for convenience foods. One UK importer of horticultural produce indicated that he would be willing to enter into a contract for 40 tonnes of frozen pigeonpeas per month if only a supplier could be found. The large Indian and Afro-Caribbean communities in Europe and North America offer new potential markets that can be accessed through the application of improved processing technologies such as freezing. The recent introduction of refrigerated containers to the Kenyan market has relieved the major constraint to such an approach, and already exporters in other sectors are taking advantage of this facility.

Kenya, with its well-developed horticultural industry, has exported small quantities of fresh pigeonpeas to the United Kingdom for several years. The smallholder growers have contracts directly with commercial horticultural exporters who supply UK supermarkets with a variety of fresh vegetables. This trade used to be very seasonal in nature because of the phenology of the traditional long-duration varieties grown by farmers. With the introduction of short- and medium-duration determinate varieties that are not so temperature- and photoperiod-sensitive, it is now possible to supply fresh pigeonpeas all year round.

Based on its ongoing work in Kenya, in 1999 ICRISAT arranged for the testing of fresh peas from 15 improved short-duration varieties to determine their storability and sugar content within the existing delivery chain used by a commercial horticultural exporter. Samples were also sent to the United Kingdom for market evaluation purposes. Helpfully, the results demonstrated that there were significant differences in the parameters tested, an important learning step. But importantly, it was also learned that the UK market was more interested in green pigeonpeas rather than those with a purple

seed coat – valuable information to feed back into the development process.

ICRISAT, with TechnoServe and other partners, is now exploring how best to move forward to develop this nascent industry. An interesting feature of the horticultural sector is the close integration between the buyers on the one hand and the producers on the other. Quality is such an important consideration for horticultural exporters that these companies even employ graduate agronomists to work with contract growers to advise on all aspects of crop production.

6 ADDRESSING SEED SUPPLY ISSUES

An important technology component to increase pigeonpea productivity, grain quality and production timing is first the introduction of new germplasm, then ensuring a regular seed supply to maintain grain quality. Private investment in new seeds, production methods and post-harvest systems is unlikely in advance of the market being prepared to pay for these products and services, but introducing the market to new products and standards is difficult without adequate levels of production.

Before embarking on a seed intervention, it is important to understand existing seed systems. For non-hybrid crops such as pigeonpeas, farmers invariably use own-saved seed, and if for any reason seed is lost they can usually access it from a range of sources including social networks and local grain markets. Farmer seed systems are both resilient and flexible even under extreme conditions, and experience shows that they are reluctant to pay large premiums for certified seed except for hybrids where, because hybrid vigour declines in farm-saved seed, there is a strong incentive to buy each year. As a result, commercial seed companies in eastern and southern Africa largely focus on hybrid seed production. Test-marketing of small seed packs has shown that farmers are willing to purchase small quantities at prices several times higher than the grain price, but once they have access to the germplasm they will then save their own seed rather than returning to the seed market (see Tripp, 2001). For self-pollinated crops like beans and groundnuts recycling seed in this way poses few problems, but for crops like pigeonpea where there is some degree of out-crossing, varietal integrity will change over time. For farmers this is not necessarily a problem because they often practise some sort of selection, but for markets where grades and standards are important there is a need to maintain varietal integrity. Under such circumstances, marketing of small seed packs so that farmers can access new germplasm is not sufficient; there needs to be a constant supply of fresh seed even if farmers do not replace it every season.

There are very real benefits to traders, processors and farmers in meeting the more stringent quality standards demanded by European buyers, and in being able to supply pigeonpeas at a time when market prices are highest. In the cotton sub-sector it is common for cotton ginneries to supply seed to farmers to maintain the quality of cotton delivered to the ginnery. Similar institutional arrangements are possible to supply

pigeonpea seed to farmers. In Tanzania, a subsidiary company to the exporter of pigeonpeas to Europe has started multiplying seed of ICEAP 00040, and in Mozambique cotton companies have started to address seed supply issues by contracting a commercial seed company to multiply seed that is then distributed to farmers by the companies themselves. Unfortunately in Malawi, the well-intentioned actions of humanitarian agencies in distributing free seed season after season undermine any incentive for the private sector to establish more sustainable seed supply options.

Another constraint to making improved germplasm available to farmers is the outdated national policies on mandated new varietal testing and approval processes. These are further complicated by a general lack of regional coordination and policy harmonisation, creating international barriers to the dispersion of, and trade in improved seed. On-farm trials and discussions with industry players have confirmed the suitability of several improved pigeonpea varieties, but it has taken more than five years to have these released in some countries. Such delays are not acceptable in a rapidly evolving and highly competitive market such as that for pigeonpeas.

7 WHERE NEXT?

The examples presented in this paper have tried to highlight the need for close integration between agricultural research and commercial marketing to seek opportunities that will benefit smallholder farmers. Unfortunately investment in agricultural research throughout Africa is declining, which threatens the long-term viability of agricultural enterprises driven by commercial needs. Ultimately there is a need for the private sector to invest in research, but in the meantime national governments and development investors need to consider how to support research provided that agricultural researchers are prepared to go out and engage in strategic partnerships with the private sector for impact.

8 CONCLUSIONS

Globalisation continues to be an extremely contentious topic, and is being strongly resisted by many in the international development community. Without doubt many of their concerns are justified, but at the same time it is hard to argue for a return to the previous status quo that did little over several decades to improve rural livelihoods, especially of poor smallholder farmers living in low-potential areas. Unfortunately the legacy from that time lives on, and although significant advances have been made in the understanding of rural livelihoods, little of substance has emerged to redress the balance. A new paradigm is needed that goes far beyond the superficiality of many existing approaches. There is an urgent need to change the way that we all do business, otherwise smallholder farmers in Africa, especially those in marginal environments, will become even further marginalised as others seize the opportunities and run with them. In the past agricultural researchers largely focused their efforts on increasing crop productivity without paying much attention to

profitability. It was assumed that farmers would readily adopt supply-side interventions, but the reality has been somewhat different. Attitudes are beginning to change among researchers, and there is now widespread agreement that, to ensure the relevance of agricultural research, farmers need to be involved in the selection, testing and evaluation of improved agricultural technologies. Unfortunately, this approach is yet to be extended much beyond the farm gate to the traders, processors and consumers of crops who together comprise the market that farmers are increasingly anxious to participate in. Unless farmers can find a ready market that is sufficiently attractive relative to other enterprises, they will still be reluctant to invest in new technologies. Many actors involved in agricultural research and development are suspicious of the market and the role played by the private sector. Middlemen are still despised for the excessive profits they make from the labours of others rather than recognised for the very considerable risks they often take. The types of arrangements described in this paper indicate that there is a role for many different actors, but these actors need to work towards a common goal through the development of strategic partnerships for the benefit of smallholder farmers. Unfortunately there is insufficient understanding by policy makers and development investors of what needs to be done to foster such partnerships. This paper does not pretend to provide all the answers, but it is hoped that the description of the market-based approach focused on a well-adapted crop grown by some of the poorest farmers in Africa will be of interest.

Agricultural researchers have developed pigeonpea varieties that are both higher-yielding and can meet the precise and varying quality requirements of end-user needs in terms of their grain size, colour, processing characteristics and delivery to market. Adoption of these new seed technologies is hampered by a lack of access to improved seeds as well as the lack of established quality standards within local market systems that can reward farmers for producing a differentiated product in terms of grain size and colour, quality or cleanliness.

Without the necessary market incentives, farmers are less likely to invest in improved seed and realise the productivity and quality gains that have been demonstrated from planting improved varieties. Even if farmers were sufficiently attracted by the superior agronomic performance (higher yield, early maturity or disease resistance) the lack of improved seed would be a major constraint to the adoption of improved germplasm.

The introduction of simple and easily administered quality standards, based on end-user needs, can help farmers, traders and exporters to benefit from niche markets that demand higher quality standards than the traditional export market for FAQ grain. The realisation of price incentives will stimulate investment by interested parties in seed multiplication of improved pigeonpea varieties. Success in pigeonpeas could be replicated in a wide range of other pulses and products.

Regional partnerships among international research

institutions and business development agencies, working in close collaboration with the private sector and local institutions, hold great promise for identifying and implementing solutions to these complex constraints to agricultural and economic development.

REFERENCES

- Ackello-Ogutu, C. and Echessah, P. (1998) 'Unrecorded cross-border trade between Malawi and neighboring countries'. *Technical Paper* No. 87., Nairobi: USAID/Africa Bureau, Regional Trade Agenda Series.
- Bantilan, M.C.S. and Joshi, P.K. (1996) 'Returns to research and diffusion investments on wilt resistance in pigeonpea'. *Impact Series* No. 1. Patancheru, Andhra Pradesh: International Crops Research Institute for the Semi-Arid Tropics.
- Carney, D. (1999) 'Approaches to sustainable livelihoods for the rural poor'. *ODI Poverty Briefing* 2, January, London: Overseas Development Institute.
- Eicher, C.K. (1999) 'Institutions and the African farmer'. Third Distinguished Economist Lecture. Mexico D.F.: International Maize and Wheat Improvement Center.
- FAOSTAT (1998) FAO statistical database. Rome: Food and Agriculture Organization of the United Nations.
- Freeman, H.A., Jones, R.B., Silim, S.N. and Ochere, M.A. (1999) The pigeonpea sub-sector in Kenya. Mimeo.
- Freeman, H.A., Silim, S.N., Jones, R.B. and Ochere, M.A. (1998) Pigeonpea situation and outlook in southern and eastern Africa. Mimeo.
- IFAD (2001) Rural poverty report 2001: *The challenge of ending rural poverty*. Oxford: Oxford University Press.
- Jaeger, P.M.L. (1998) 'The Indian market for East African pigeonpeas (*Cajanus cajan*)'. Mimeo.
- Lin, J.Y. (1998) 'Agricultural development and reform in China' in C.K. Eicher and J.M. Staatz (eds) *International agricultural development*. Baltimore: Johns Hopkins University Press.
- Lo Monaco, G. (2001) Report on the pigeonpea sub-sector. Mimeo.
- Maxwell, S. (2001) 'Agricultural issues in food security' in S. Devereux and S. Maxwell (eds) *Food security in sub-Saharan Africa*. London: ITDG Publishing.
- Ritchie, J.M., Abeyasekera, S., Chanika, C.S.M., Ross, S.J., Mkandawire, C.B.K., Maulana, T.H., Shaba, E.R. and Milanzi, T.T.K. (2000) 'Assessment of improved pigeonpea varieties under smallholder management' in J.M. Ritchie (ed.) *Integrated crop management research in Malawi: developing technologies with farmers*. Chatham, UK: Natural Resources Institute.
- Saxena, K.B., Chauhan, Y.S., Laxman Singh, Kumar, R.V. and Johansen, C. (1996) Research and development of hybrid pigeonpea. *Research Bulletin* No. 19. Patancheru, Andhra Pradesh: International Crops Research Institute for the Semi-Arid Tropics.
- Silim, S.N., Omanga, P.A., Johansen, C., Laxman Singh, and Kimani, P.M. (1994) 'Use of the Kenya transect for selecting and targeting adapted cultivars to appropriate production systems' in S.N. Silim, S.B. King, and S. Tuwafe (eds) *Improvement of pigeonpea in eastern and southern Africa – annual research planning meeting 1994*. Patancheru, Andhra Pradesh: International Crops Research Institute for the Semi-Arid Tropics.
- Tripp, R. (2001) *Seed provision and agricultural development. The institutions of rural change*. Oxford: James Currey.
- World Bank (1999) *World Development Indicators*, Washington D.C.: World Bank.

ENDNOTES

- 1 These figures conceal important variations. The share of agricultural GDP ranges from 3% in Botswana to 58% in the Democratic Republic of the Congo; value of export share from 0.1% in Angola to 84% in Burundi; and labour force in agriculture from 16% in Mauritius to 95% in Rwanda.
- 2 Pigeonpea statistics are not routinely collected by most governments and for some countries like Mozambique that was affected by war for nearly 18 years, no reliable statistics are available.
- 3 Dhal is made by removing the seed coat and splitting the cotyledons. Dhal made from pigeonpeas is referred to as *Tur dhal*, although the terms *Toor*, *Tuver* or *Arhar dhal* are also used to describe the same product.
- 4 Australia made significant investments in pigeonpea research, but the crop has never really taken off in that country.

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