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A Value Chain Analysis for Pigeon Pea in the Southern Regions of Tanzania

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Executive Summary

Key findings from the value chain analysis are:

- Tanzania's growth in production of 127% between 2009 and 2011 has moved her up above Malawi as now the third most important global pigeon pea supplier approaching production of 300,000mt per year.
- The value chain for pigeon pea in Tanzania is dominated by two large international trading houses: Export Trading and Mohammed Enterprises.
- Lack of government interference in pigeon pea marketing is considered a positive advantage by most actors interviewed.
- 80% of farmers in the areas surveyed in South Eastern Tanzania are now growing pigeon pea.
- Productivity is very low under mixed farming – typically 150kg/ha intercropped with maize and others.
- Pigeon pea is becoming an important cash crop in Southern Tanzania, but still contributed to household diets.
- Currently pods and stems are not utilised at all.
- The market for fresh pigeon pea is much larger than expected (at least 10% of total production) and represents a market growth opportunity. Some villages and particularly women's groups specialise in this market.
- Post-harvest losses of stored pigeon pea through pest attack are particularly high and force farmers to sell when prices are low.
- A high proportion of the total crop of 272,000 is exported (about 70%). Currently less that 0.2% is processed domestically into dhal prior to export.
- The analysis identified five distinct value chain for pigeon pea from Tanzania: (1) bulking for export to India; (2) local sales of dried grain; (3) sale of fresh product as a vegetable; (4) retention and sale as seed; and, (5) local processing and export of dhal (Babati and Arusha only).
- Gross margin analysis of pigeon pea and some of its competing crops suggests that farmers returns are lower than sesame and Bambara groundnut Tsh 194,000, and Tsh 151,600 for sesame and Bambara, compared with Tsh 59,160 for pigeon pea). However, with improved varieties and better management margins of Tsh 230,000/ha are possible.
- There may be opportunities for upgrading the quality, and therefore price, of Tanzanian pigeon pea. Currently, a key advantage held by the exporters is an understanding of the grading structure of the Indian Dhal market. Where premiums exist currently, these are not passed onto farmers. The market prefers not to have small seeds, but otherwise all varieties are accepted

This report presents the value chain analysis for pigeonpeas in the South-eastern Tanzania. The study is part of the ICRISAT project "Enhancing Productivity of Groundnut and Pigeon pea Cropping Systems in Eastern Africa". Specifically, it forms part of Output 3: Structure, conduct and performance of value chains for groundnut and pigeon pea. In this output includes two activities: firstly Map existing value chains and identify constraints on market performance and secondly test innovations to enhance performance of the value chain.

The information for analysing the value chain for pigeon pea were collected in Tanzania, specifically focusing in the South-eastern part of Tanzania which includes Mtwara and Lindi regions and Tunduru district in Ruvuma region. The work was conducted in three phases: initial scoping, in-depth interviews of different actors along the chain and final write-up between mid-March and July 2013 as collaboration between Naliendele Agricultural Research Institute (NARI) and the Natural Resources Institute (NRI), UK.

The findings revealed that, Southern Tanzania (and Northern Mozambique) has great potential for increased pigeon pea production. Production of pigeon pea is relatively stable in the North of Tanzania but growing quickly in the Southern Region. This suggests that traders have fully exploited the potential in the North and are now competing for material from the Southern production areas. Improved seeds and relatively small changes in management practices would substantially increase supply.

Currently there seems to be no in-country premium for quality. Pigeonpea quality (e.g. size, colour, damage) is not a key determinant of price. Traders are buying everything and no discounts or rejections seem to occur. The literature seems to suggest that these factors are important, but we found very limited evidence from key informants in the value chain to support the 'Babati premium' story.

In the South-eastern Tanzania there are no improved pigeon pea production practices (e.g. no improved seed, external inputs or intensive production). In the Northern part of Tanzania farmers buy uncertified seed and spray against pests. This seems to be largely as a result of their more intensive farming system. Naliendele Agricultural Research Institute (NARI) need to develop improved varieties and management practices appropriate to the farming conditions in the Southern Agricultural Region and disseminate them to the farmers for increased productivity.

Currently there are two lead actors in Tanzania in the pigeon pea export sector. The pigeon pea lead actors in Tanzania seem to be Export Trading Group and Mohammed Enterprises. These lead actors are multi-nationals, able to benefit from applying sophisticated commodity market instrument to even out risk. However, Export Trading Group (ETG) is more advanced compared to Mohamed Enterprise in terms of capital investment in pigeonpeas. ETG has a processing plant in Arusha in the Northern part of Tanzania. ETG export dry processed pigeonpeas (dhal) to Middle East and India. These companies buy an average of 2,000 to 6,000 tons per season. Mohamed Enterprise bought 1,257 tons from Southeastern Tanzania, while ETG had 6,000 tons of dry pigeonpeas in the store bought during 2012 season. Other exporting companies reported were PRAYOSA and M.S. Impex. There were several agents in the rural areas buying on behalf of these companies. Also speculative traders were buying and sell to these exporting companies.

Keywords: Value chain, Pigeonpeas, Sothern Tanzania, Exports

JEL classification: Q110, Q130, Q170

Contents

1.0 Introduction

This report presents information gathered on the value chain for pigeon pea in Tanzania, specifically focussing in the South-eastern part of Tanzania which includes Mtwara and Lindi regions and Tunduru district in Ruvuma region. The work was conducted in three phases: initial scoping, in-depth interviews and final write-up between mid-March and July 2013 as a collaboration between Naliendele Agricultural Research Institute (NARI) and the Natural Resources Institute (NRI), UK, and was funded by ICRISAT under a grant from the European Commission.

The value chain analysis for pigeon pea is part of the ICRISAT project "Enhancing Productivity of Groundnut and Pigeon pea Cropping Systems in Eastern Africa". Specifically, it forms part of Output 3: Structure, conduct and performance of value chains for groundnut and pigeon pea evaluated. In this output includes two activities: firstly "3.1 Map existing value chains and identify constraints on market performance", and, secondly, "3.2 Test innovations to enhance performance of the value chain".

Legumes, including pigeon pea and groundnut, are increasingly important elements of cropping systems in East Africa. As we shall see, opportunities for cash income have driven a considerable increase in planting throughout its range, particularly in Tanzania and Malawi, largely as a convenient inter-crop. In Tanzania, the focus of activities to date seems to have been around Babati in the North of the country where new seeds have been tried. However, in the Southern Tanzania, there are no improved seeds and no recommendations for better management practices available. This project, therefore, aims to increase food security for selected farming areas through increased yield and value of pigeon pea.

The objective of the research was: to identify the key actors in the Southern Tanzanian value chain and clarify their roles and responsibilities; draw lessons from the commercialisation of pigeon pea in Northern Tanzania relevant to the South; and, find key success factors and upgrading opportunities relevant to further research and development work to ensure that this is driven by the market (as opposed to the agenda of researchers).

This report is laid out as follows; it starts with Introduction which include background, production and marketed volumes of pigeonpeas in the Southeastern Tanzania, Export Vs domestic consumption, prices, International market competition, grain quality and consumer preferences, and value chain issues identified in the literature. This is followed by Method and Scope which presents conceptual framework, methodology of the study, research questions, methodological tools, gross margin methods and also sampling criteria. The third section presents the Southern Tanzania pigeonpea value chain which also includes subsection presenting value chain actors, value chain map, explanation of the pigeonpea value chain map and structure conduct and performance of the value chain. The other sections presented issues arising from the value chain analysis feeding back into the Southern Tanzania pigeonpea value chain from India; India standards and quality perceptions; the Indian pigeonpeas price structure; key findings, issues and themes for future research and lastly recommendations.

2.0 Theoretical framework

Pigeon pea (*Cajanus Cajun*) is a grain legume. In Tanzania it is used as a fresh green vegetable and, once dried, as a bean. Pigeon pea's biggest use is as 'dhal', a soft paste made from rehydrated decorticated pigeon pea seed which is a staple in the diet of South India. Dhal is made at an industrial scale by soaking whole peas, de-hulling and splitting. Dhal manufacture overcomes the considerable challenge of storage for pigeon pea by making a stable product which can be easily reconstituted. Attempts to encourage Tanzanian's to eat Dhal seem to have met with limited success.

World production of pigeon pea is growing (see Table 1 below). The driving force behind this is growth in Indian domestic demand (Jones et al, 2002). These figures suggest that Tanzania is rapidly becoming an important strategic origin for pigeon pea for export to India. Tanzania's growth in production of 127% between 2009 and 2011 has moved her up above Malawi as now the third most important global pigeon pea supplier approaching production of 300,000mt per year.

The key drivers of this growth seem to have been changes on the supply and demand profiles within the Indian economy. Rapid urbanisation and development means that productivity in the domestic agricultural economy in India is not keeping pace with demand. India is looking elsewhere for supplies of strategic food. Traditionally, shortfalls in Indian production have been made up by exports from Burma, but recently these have proved insufficient.

Table 1: World Pigeon pea production - India and its main suppliers 2009-11

Country	2009		2010		2011	
	Production (Mt)	Proportion of world supply (%)	Production (Mt)	Proportion of world supply (%)	Production (Mt)	Proportion of world supply (%)
India	2,270,000	64.1	2,460,000	63.9	2,860,000	64.9
Kenya	46,474	1.3	103,324	2.7	84,313	1.9
Malawi	184,156	5.2	193,005	5.0	195,516	4.4
Burma	765,000	21.6	772,999	20.1	837,385	19.0
Uganda	91,000	2.6	93,000	2.4	94,861	2.2
Tanzania	120,870	3.4	166,130	4.3	272,608	6.2
Total India and suppliers	3,477,500	98.2	3,788,458	98.3	4,344,683	98.6
Total World Production	3,542,598	100.0	3,852,110	100.0	4,405,984	100.0

Source: FAOSTAT

Table 2 below with slightly earlier data suggests a very high degree of variability in Tanzanian pigeon pea production which seems to be strongly related to yield and therefore rainfall.

Table 2: National Area ('000'ha), Production ('000'tons) and Yield (tons/ha) by Region and Year

Region	2005/2006	2006/2007	2008/2009	2009/2010
Arusha Area	7.45	9.56	13.46	21.17
Arusha Production	12.77	10.99	10.34	18.88
Dodoma Area	1.43	2.79	13.94	20.68
Dodoma Production	0.92	2.95	6.07	13.38
Kigoma Area	4.26	0.00	9.24	9.71
Kigoma Production	4.96	0.00	3.54	5.87
Kilimanjaro Area	0.87	2.02	0.55	0.31
Kilimanjaro Production	0.56	1.75	0.19	0.39
Lindi Area	14.38	20.06	18.26	41.17
Lindi Production	14.25	13.45	14.85	26.21
Manyara Area	47.28	38.35	43.86	48.59
Manyara Production	40.51	32.08	4.40	31.59
Mbeya Area	0.21	0.22	0.22	0.22
Mbeya Production	0.40	0.35	0.26	0.26
Morogoro Area	0.80	2.31	2.48	3.70
Morogoro Production	1.04	1.93	1.37	2.23
Mtwara Area	55.20	12.27	5.98	30.68
Mtwara Production	64.35	10.63	21.56	30.89
Shinyanga Area	5.62	12.28	5.94	10.78
Shinyanga Production	3.94	3.29	4.18	8.90
National Pigeon pea Area	137.49	99.83	113.91	187.01
National Pigeon pea Production	143.70	77.44	66.76	138.59

Source: Statistics Unit, Ministry of Agriculture, Food Security and Cooperatives

The key production zones for Pigeon pea in Tanzania are Arusha, Dodoma, Manyara and Mtwara. In the 2009/10 cropping season the Southern Agricultural Regions of Tanzania (Lindi and Mtwara) accounted for approximately 41% of total national pigeon pea production with most of the rest coming from the three Northern Regions of Manyara, Dodoma and Arusha.

Yields under traditional production systems are extremely variable, though the authors have some doubts about the quality of this data (see for example the yield per ha in Mtwara which varies between 1,165kg/ha in 2005/6 and 3,605kg/ha in 2008/9). These figures also seem to suggest that yields in Mtwara are consistently better than other production areas in Tanzania, notably the Babati production region, which again the authors would treat with scepticism.

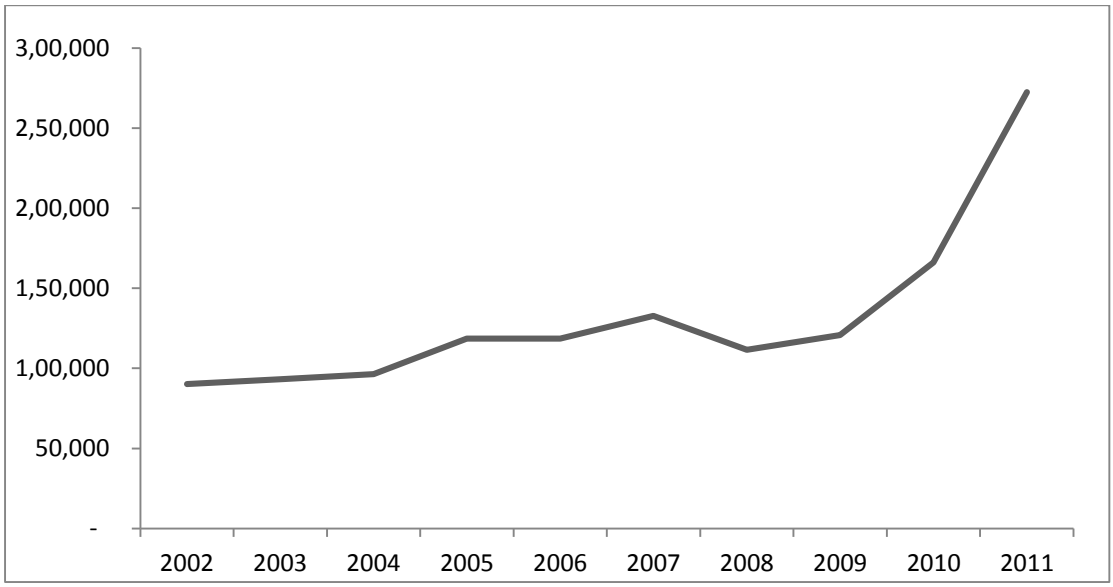
Looking at the FAO statistics for production and yield for Tanzanian pigeon pea over the period 2002 – 2010 (see Table 3 and Figures 1 and 2 below) it can be seen that: a) there have been gradual productivity gains over time; b) recent dramatic growth in production has come from change-of-land-use and not productivity gains.

Table 3: Long-term pigeon pea production and yield

Element	2002	2003	2004	2005	2006	2007	2008	2009	2010
Area Harvested (Ha)	138,748	143,451	142,100	162,400	162,400	151,241	125,000	113,910	187,010
Yield (Kg/Ha)	6,500	6,500	6,777	7,297	7,297	8,775	8,923	0,611	8,883
Production (mt)	0,186	93,243	6,300	118,500	118,500	132,717	111,540	120,870	166,130
Seed (mt)	2,869	2,842	3,248	3,248	3,025	2,500	2,278	3,740	5,763

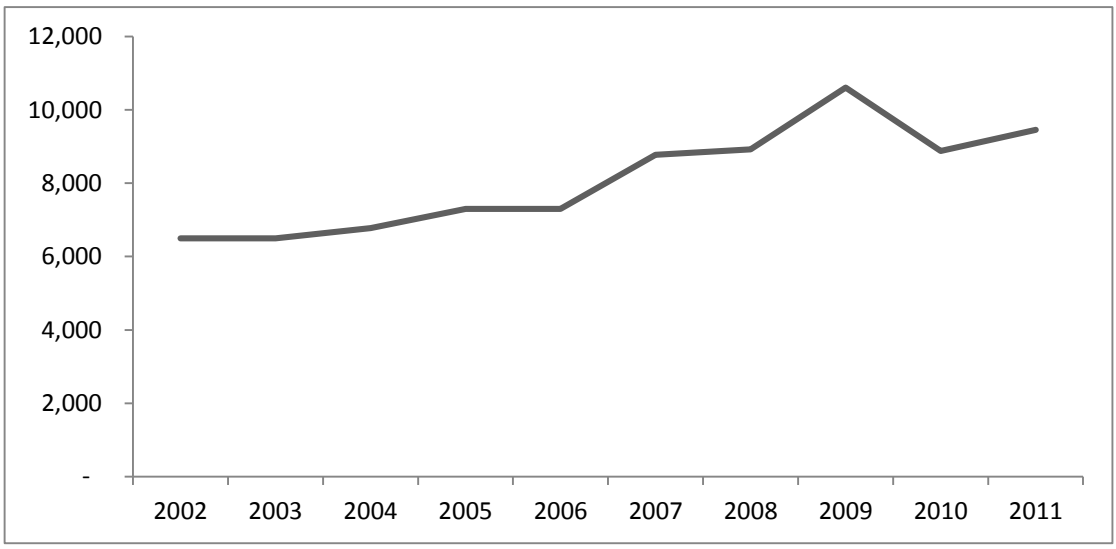
Source: FAOSTAT

Figure 1: Tanzanian pigeon pea production 2002-10 (mt)



Source: FAOSTAT

Figure 2: Tanzania pigeon pea yields 2002-10 (Kg/ha)



Source: FAOSTAT

This rapid and recent growth in cropping area belies considerable underlying production inefficiencies in Tanzania. Lo Monaco (2006) talks of a long history of under investment in pigeon pea with limited use of inputs and poor crop management leading to an average yield in the region of around 600kg/ha falling to 350kg/ha under subsistence production regimes. Previously, at least a third of pigeon pea was consumed on-farm in the region(Muwalo E S, Paliani A et al. 1999), but this has now changed with the majority sold into the various value chains described below.

Much of the literature has now been overtaken by events as the value chain for pigeon pea has started to respond to economic growth in India.

In Tanzania ICRISAT has a long and fruitful collaboration with Ilonga Research Station in Kilosa for breeding and the Selian Agricultural Research Institute (SARI) in Arusha that covers the Northern Zone of Tanzania. Here, improved varieties like ICEAP 00040 and ICEAP 00053 have become popular with high uptake rates. In Babati District – famous for quality pigeon pea production – adoption levels have reached 60%.ICRISAT-bred varieties seem to have had a substantial impact on farmers in terms of increased productivity accompanied by good management practices unlike in the South-eastern part of Tanzania where little research works has been done. In Southern Tanzania more than 90% of farmers still plant local varieties and also the use of traditional management practices which results in low productivity. We note that there is a very promising variety suitable for release in Southern Tanzania (ICEAP 00557) in the final stages of the release process.

2.1 Production and marketed volumes of pigeon peas in South-eastern Tanzania

The interviews conducted during the value chain analysis show that the majority of farmers (80%) in the major pigeon peas growing districts of Southern Tanzania, namely Masasi, Nachingwea, Nanyumbu, RuangwaKilwa, Lindi Rural and Mtwara in the South-eastern Tanzania are now growing pigeonpeas.More than 90% of farmers interviewed were growing local varieties. The average farm size ranged from 0.25 to 3 acres per household. Reserved

harvest was the major source of seed for the next planting season; only 38% of the farmers were buying from retailers in the local market. Normally pigeon peas are grown mixed with maize, sorghum, sunflower, cassava or upland rice. Only 12% of the farmers interviewed reported using pesticides. Under mixed farming the average productivity per acre was 150kg of dry shelled pigeon peas. After harvesting about 30% was consumed at household and also some amount reserved for seed and the rest were sold. The crop residues and pods are burnt in the field; this is another area which requires an intervention because the pods are known to be good source of protein for animal feeds. Major challenges reported by farmers were in pigeon peas production include field and storage pests and also low prices offered by buyers.

We also put some effort into collecting local production and marketed volumes data for pigeon pea. Production estimates are made at District Agricultural Offices and this data was collected directly from them. In other Districts like Kilwaand Ruangwathey didn't have information on pigeon peas production since in previous years the crop had less priority as a cash crop; most of the pigeon peas were consumed at household. However, in the past two years traders started buying through establishing purchasing points in the villages. Marketing estimates (e.g., the volume sold by farmers into the formal market and potentially subject to levy) were collected by the District Treasury Officer. We had hoped that this would provide a strong picture of production and marketing activity. However, the data is highly variable, in some cases not present. The marketing figures for these areas suggest that most is consumed on farm. It may be that some of this can be explained by tax evasion, but seems more likely that mis-reporting is to blame. These figures are presented in Annex 7.

2.2 Export vs. domestic consumption

There seems to be a common feeling among actors nearer the end market and in Government in Tanzania that a high proportion of the pigeon pea crop processed and exported. The value chain analysis found that approximately 30% of the total harvest is consumed domestically (about 90,000mt). Of the total pigeon pea harvest of 272,000mt only 600mt (0.2%) is processed locally into dhal (in Arusha) and exported pre-packed to the Middle East. Clearly more opportunities for simple local dhal manufacture for export exist.

In Tanzania it is almost entirely a small-holder crop and commonly an inter-crop with maize, cassava and groundnut due to its good fit with these crops for labour utilisation (e.g., you can weed pigeon pea and harvest maize in the same cycle).

2.3 Price

Price trends for pigeon pea are difficult to obtain because much of the trade in this product is between trading houses of Indian origin and their East African agents.

Tanzania has a seasonal advantage in pigeon pea production. The availability of domestic pigeon pea in India wanes after harvest and this coincides with Tanzanian production. How important this factor is in setting domestic prices is uncertain. Lo Monaco (2006) questions this commonly held view observing that Indian traders will purchase pigeon pea from other markets (e.g. Burma) before East Africa is there is availability. It is the experience of the authors, working on other Tanzanian export crops such as sesame that Indian buyers tend to prefer Burmese sources over African ones when stocks are available.

2.4 International market competition

Pigeon pea is exported in volume from Malawi and Kenya as well as Tanzania. In the early 2000's Malawi seems to have had a comparative advantage over Tanzania, but recent economic problems and rising transport costs seem to have dissipated this head-start (Makoka 2009). These changes in cost dynamics in the region may explain why Tanzania has over-taken its regional competitors in volumes of pigeon pea exports.

Traditionally, shortfalls in domestic Indian supply of pigeon pea have been made up with imports from Burma and East Africa. More recently, the availability of yellow pea (*Pisumsativum*) from Canada and France has challenged the supremacy of pigeon pea for dhal manufacture in India as it is a cheap alternative at the lower income end of the market and can replace more expensive chick pea in flour.

2.5 Grain quality and consumer preferences

According to Lo Monaco 2006, the price premium for African pigeon peas is related to preferences in the Indian market. The preference for African pigeon peas is due to the large size and cream coloured seeds traits characteristic of the most valued variety, the Tanzania Babati white, by inference and judging from results of previous studies those are the grain qualities preferred in the Indian market.

For the milling industry, milling yield is the most important criterion in assessing pigeon peas variety. Milling performance is determined in terms of grain to dhal conversion rates and the overall costs of the operations need to obtain a specific quality level in the final product. These are the most important grain traits related to milling performance;

1. Size; large grains generally give higher recovery rates
2. Shape; roller machines use a revolving mechanism, so round grain yield more than oval ones
3. Ease of dehulling (inversely, the tenacity of adhesion between tegument and cotyledons). Ease of dehulling is measured in terms of number of passages in the roller machine needed to obtain dhal. Varieties with looser husk are cheaper to process.
4. Colour
5. Cleanness
6. Homogeneity
7. Content of immature grains- cleanness, homogeneity and admixture of grains are all directly related to processing losses during cleaning and sorting.

Previous studies found that large grains, white colour, and round shape are positively associated with higher market prices (Lo Monaco cited Von Oppen, 1981, ParthasarathyRao*et al*., 1991)

Also according to Lo Monaco 2006, the important factors in dhal consumer preference were sweetness of taste and ease of cooking. These characteristics are not immediately identifiable when buying the dhal. Consumers therefore assess grain quality by the physical characteristics of the split grains; sharpness of the edges of split grains, the fewer immature grain the better and the less the seed coat residues on the outer part of the grain halve the better.

2.6 Value chain issues identified in the literature

Coote (2012), summarising the recent literature on pigeon pea in Southern and Eastern Africa, concludes that they key problems in the value chain are low prices at farm gate, lack of improved seeds and the perception that the value chain is exploitative of farmer. We shall review these issues below.

In her review of the Babati value chain for pigeon pea, Rogarth(2010) highlights the importance of seeds supply, contract growing and early developing varieties to benefit from high inter-seasonal price variation as key to success.

Amari et al (Amari, Asfaw et al. 2012) demonstrate the strongly positive economics of a maize/pigeon pea intercrop and highlight seed supply and market information asymmetry as key constraints to value chain development.

ICRISAT (Jones, Ade Freeman et al. 2002; Lo Monaco 2006) focus on the apparent success of the 'Babati model', meaning the introduction of new short-season white seed coloured varieties in the late 1990's and early 2000's with support from Technoserve(Massawe 2001). This approach focussed on selling pigeon pea to processors in Kenya (who largely on-sell dhal to Europe) and to a premium niche market identified in Europe for whole, white seeds (Jaeger P, (1998) cited in Jones, Ade Freeman et al. 2002; Shiferaw, Okello et al. 2008). Interviews by the Team in Babati suggest that this strategy has now changed with Export Trading sending most of their seed to India for processing, but retaining a relatively small amount for processing into dhal which is then sold to the premium Middle Eastern market. The absence of export data on pigeon pea (neither Kenya nor Tanzania disaggregate 'peas' in their trade data making a sensible estimate of the proportion of Tanzanian pigeon pea exported through Kenya impossible).

3.0 Method and scope

3.1 Conceptual framework

Value chain analysis considers all of the actions, actions and activities that bring a product from point of production (and pre-production) to consumption. It addresses the questions of who are the actors in a chain, how are they linked to each other (i.e., how is the chain 'governed'), who holds the influence in a chain (i.e., 'power') and how can actors in the chain gain more value and influence (i.e., 'upgrading') (Kaplinsky and Morris 2000).

The scope and depth of application of value chain analysis depends on the research questions being addressed and the resources available to answer those questions. In this case, given limited research resources and time, the research team adopted a pragmatic and rapid approach to interpreting value chain analysis. This approach trades off empiricism against more qualitative methods. The reader should not expect the degree of detail of other similar studies (Shiferaw, Okello et al. 2008), however, the aim here is merely to guide future investment and research with up to date market information in a timely and cost effective manor.

We can find no previous attempts at describing the pigeon pea value chain in Southern Tanzania. Several studies have looked at the Babati area (Rogarth 2010) or at pulses in general (Chemonics 2010). As we shall see, the pigeon pea value chain is demonstrably distinct from other pulse chains in East Africa, so this general view is not helpful.

3.2 Methodology

The Pigeonpea Value Chain Analysis Team (hereafter referred to as "the Team") adopted a phased method to undertaking this research. Firstly, existing literature was reviewed and summarised (see 'background' above). Secondly, the Team conducted a rapid scoping to identify value chain entry points, key actors and likely upgrading opportunities for further in-depth analysis(Bennett, Kidunda et al. 2013). This activity, done in March 2013, was divided between three centres: the Southern Region, Babati Region and Dar es Salaam. Key informants were interviewed in the research, farming, support services, private sector non-government and policy realms (see Annex 1). This phase developed a broad overview of

the chain and focussed the research questions so that a methodology could be developed to better understand the pigeon pea value chain in the Southern Regions (Mtwara and Lindi) of Tanzania. In this phase a workshop was held to define the key chain actors develop the research methodology. The workshop came up with an outline sampling framework which allowed the work to be grounded both qualitatively and, to some extent given the brevity of the research period, quantitatively.

Table 4: sampling protocol – chain actors

Value chain actor	No. of actors	Planned sample	Sample achieved	Notes
All pigeon pea chains				
Farmer	@49,000	60	50	Southern Region only. See separate sample protocol in Box 1 below.
Primary cooperative		' – '	6	Available at least in each ward.
Speculative trader	Unknown	' – '	' – '	
Trader/agent		' –'	6	Available at least in each ward in all pigeonpeas growing districts.
Trader/exporter	4	' – '	4	
Retailers	Unknown	''	7	At least 3 in each local market
Consumers	n/a	' - '	45	Consumers' preferences were captured through farmers group discussion. Not included – almost all exported
Fresh pigeon pea chain				
Fresh pigeon pea traders (including door-to-door)	Unknown	' – '	4	Farmers sell to fresh retailers/others sell themselves to ultimate consumers.
Consumers	Unknown	50	50	All fresh consumed locally
Other actors				
Seed sellers		Nil	Nil	For pigeonpeas mainly grain retailers are seed sellers.
Agricultural chemical sellers		Nil	Nil	Farmers were not using pesticides/fertilizers.
Policy makers		' – '	1	DED Lindi Urban

Source: pigeon pea value chain methods workshop

In phase three, in-depth interviews were conducted using a series of guide questions (see Annex 3). During this phase a parallel analysis of pigeon pea farm economics was conducted to attempt to answer the question: how profitable is pigeon pea compared with its competing crops. Finally, in phase four, data gather was collated analysed in a write shop conducted in June 2013.

Box 1: sampling protocol for pigeon pea farmer interviews

The rapid value chain scoping in the Southern Region showed that there are a number of different pigeon pea cropping methods ranging from mono-cropping to complex inter-cropping with maize, cassava and other crops. It was established that maize and pigeon

pea are far-and-away the most common combination so this was chosen as the focus of the study. The team selected three Regions in the South: Ruvuma, Mtwara and Lindi. These Regions have six Rural Districts. In each Rural District the team randomly selected two villages to represent that District. In each village 5 maize/pigeon pea farmers were selected randomly from the farmer list with the assistance of local Ministry of Agriculture staff. It was also planned to interview 5 farmers which experience of the new varieties of pigeon pea which are undergoing field trials. This will take place after harvest and so will be an addendum to this report.

3.3 Research questions

During the market scoping phase the Team agreed to focus our limited resources on addressing five key questions. Table xx below summarised the questions and the methods adopted by the Team to address them.

Question	Approach/method	Result
What volume of pigeonpea is produced in Mtwara and Lindi Regions of Southern Tanzania	• Collect sales figures from Primary Cooperatives in target area for last three years. • Visit all District Agricultural Offices and get production and yield figures for the last three or four years.	Local data proved patchy and unreliable. See discussion below and Annex xx.
Who are the key actors in the value chain and their relative importance?	• For number of farmers we can use the census data and apply the yields to the production estimate developed above. • Numbers of traders/exporters can be determined by further interviews with Primary Cooperatives – a sample of 5 from each District should clarify the identify of the traders.	See Section xx: value chain analysis
What are the economics of pigeonpea production now and how might they be improved?	• Sample six Districts where we have evidence that pigeonpea production is highest in three Regions: Lindi, Mtwara and Ruvuma. In each District randomly select two villages. In each village randomly select five farmers.	See Section 3.5 and Annex 4
How efficient is the pigeonpea value chain?		Additional chain actor interviews conducted
What does the geography of the pigeonpea value chain look like?	• Data collection and mapping	

3.4 Methodological tools

The Team developed a series of guide questions (see Annex 3). These questions emerged from review of the literature and the scoping phase of the research. Since the Team identified the importance of understanding the comparative farm economics of pigeon pea compared with its competing crops, a format for gross margin was also developed.

3.5 Gross margin methods and sampling criteria

Purposive sampling technique was used to select district, villages and farmers for the study. Six pigeon peas producing districts were selected for the study. In these districts, also gross margin information on other competing leguminous crops like Bambara, sesame and groundnuts were collected. The selected districts were namely Masasi, Nachingwea, Ruangwa, Tunduru, Lindi Rural and Mtwara. Mtwara and Lindi regions has a population of 1 912 105 people and 247 055 people for Tunduru district (Census, 2002). Also the villages were selected depending on their level of pigeon peas production in the district. These villages include Mpanyani (Masasi district), Mkulupilo, Mwenge (Nachingwea district), Mbekenyela, Kitandi (Ruangwa district), Nakapanya, Sisikwasisi (Tunduru district), Sudi, Madangwa (Lindi Rural district) and Majengo, Mtendachi (Mtwara district). Then at village level, purposive sampling was used to draw pigeon peas farmers for interview, purposive sampling was used in order to get farmers who were growing local pigeon peas intercropped with maize. This was due to the fact that, local pigeon peas maize intercropping was the most common practice in the study area. In each village five farmers were selected for interview, making a total sample size of 50 respondents. A structured questionnaire was used for collecting information from sampled respondents. Spread sheets were used for analysis.

4.0 The Southern Tanzania pigeon pea value chain

This section is laid out as follows: first we construct a simple typology of actors identified in the Southern Tanzanian pigeon pea value chain including those with a governance role; secondly, a value chain map has been constructed from the interviews conducted with value chain actors and these mapped chains are described in detail. We then overlay on this analysis a discussion of prices along the value chain and issues of quality and grading norms.

4.1 Value chain actors

Twelve types of value chain actor were identified for Southern Tanzanian pigeon pea. These actors reflect the structure for cash crop marketing in the other important commodities of the area: maize, cashew, cassava, beans and sesame.

Table 5: list of value chain actors

Actor	Role/description
Farmers	Small scale producer growing about 1ha intercropped with maize (or sometimes cassava) as a cash crop. Consuming green ad hoc and sometimes selling green to specialist fresh traders. Storing and consuming dried. Storing seeds.
Farmer assemblers	Small scale producer buying and bulking limited quantities from other farmers. Selling to wholesalers and primary cooperatives.
Green pigeon pea traders	Buying from farmers. Selling to vegetable retailers or from door to door to consumers.
Informal trader/wholesaler	Buying from farmers and farmer assemblers. Selling to retailers in open markets in towns Selling to export agents and exporters.
Primary cooperatives	Acting as buying agents for export agents and exporters
Bean/legume retailers	Buying from farmers and informal traders. Selling to consumers and food vendors
Vegetable retailers	Buying from green pigeon pea traders. Selling to consumers.
Door-to-door green pigeon pea traders	Buying from green pigeon pea traders. Selling to consumers.
Food vendors	Buying pigeon pea from bean/legume retailers. Buying green pigeon pea from vegetable retailers and door-to-door green pigeon pea traders Making ‘dishes’ and selling to consumers
Export agents	Buying from primary cooperatives (and informal traders/wholesalers?). Selling to Exporters
Exporters	Buying from primary cooperatives and export agents. Selling to Importers and dhal processing companies.
Consumers	Buying dried from open market retailers. Buying fresh from open market retailers. Buying fresh from door-to-door traders. Buying ‘dishes’ from food vendors.

A number of governance actors were identified, but interviews revealed that in reality pigeon pea is largely unaffected by some of the usual value chain influences such as extension, local government, central government and cooperatives. Notably, no NGO’s are supporting improved pigeon pea production in the area.

Table 6: Pigeon pea governance actors

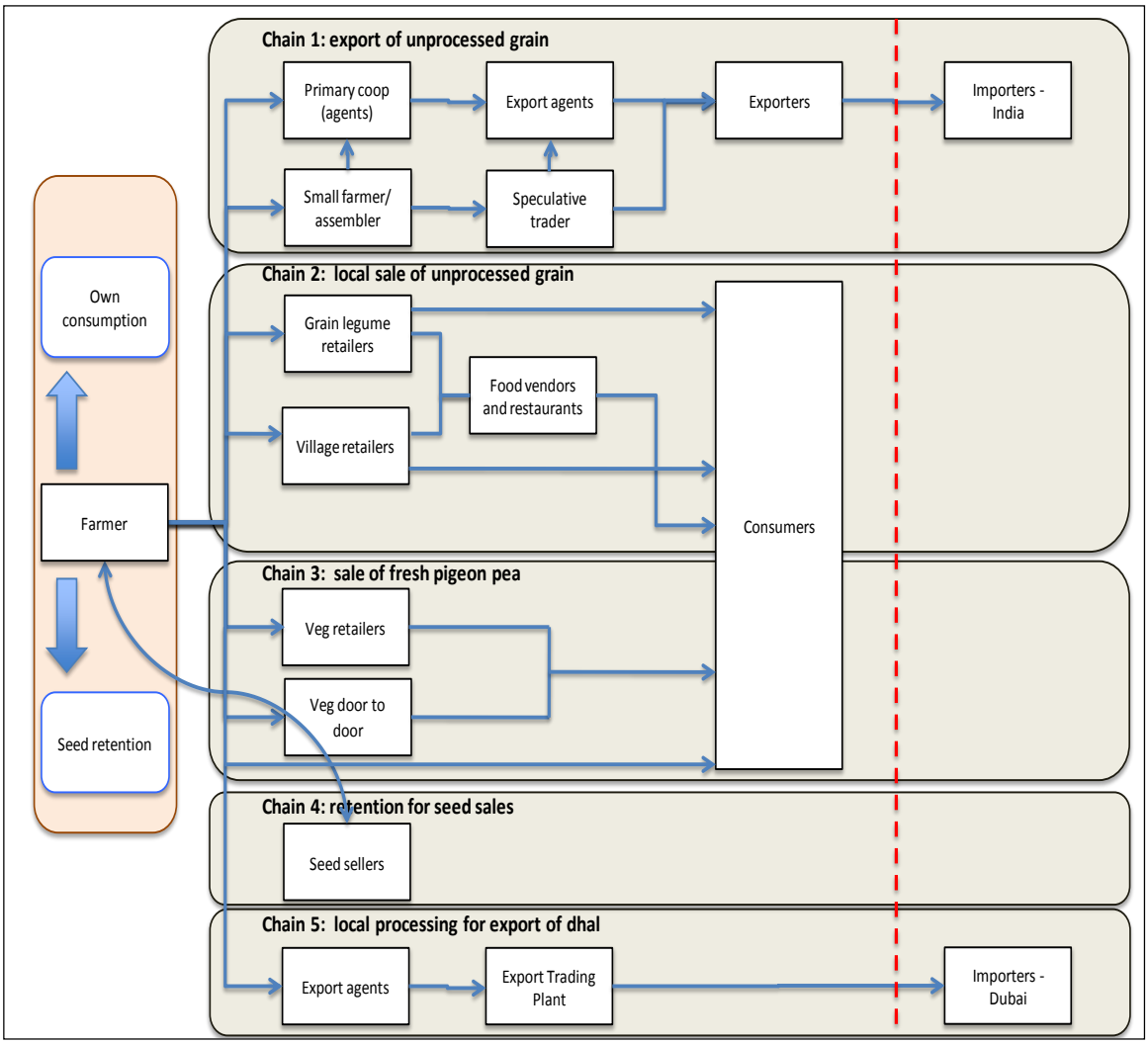
Actor	Role/responsibility
Policy makers	Setting by laws on crop cess
Local Government officials	Offer purchasing permit to traders and collecting 5% per kg as crop cess.
Extensionists	Inadequate knowledge on pigeon farming practices.
Agricultural input sellers	There was no stockist/pigeon pea seed sellers apart from local market retailers selling seed during planting season.
Cooperatives	Buying pigeon peas on behalf of speculative traders and exporting companies' agents.
NGO's and donors	Nil
Researchers	Naliendele Agricultural Research Institute conducting research on pigeon peas through cereals and legumes section.

4.2 Value chain map

During the scoping phase, the Team identified five key chains for pigeon pea (Fig. 3). These are, in order of estimated scale:

Chain 1: Bulking for export to India
Chain 2: Local sale of dried grain
Chain 3: Sale of fresh pigeon pea as a vegetable
Chain 4: Retention for resale as seed
Chain 5: Local processing and export of dhal
These five value chains are summarised in Figure 3 below.

Figure 3: Pigeon peas value chain map for South-eastern Tanzania



4.3 Explanations of the pigeon pea value chain map

Farmers were growing pigeon peas as the source of food and cash. About 15% was used for the household consumption and also as seed for the next planting season, and the rest were sold. Since different buyers sold the produce to different traders, this value chain was subdivided into five different routes namely export of unprocessed grain, local sale of unprocessed grain, sale of fresh pigeon peas, retention for seed sale and local processing for export of dhal.

Chain 1: Export of unprocessed grain

In chain 1, farmers were selling dry pigeon peas to primary cooperatives and also farmer assemblers. The average price was 500 Tshs per kilogram (kg). There were no premium price for grading and quality. In the south-eastern Tanzania, at least in most of the villages, there is an Agricultural Marketing and Cooperative Society (AMCOS).ThePrimary Societies were buying pigeon peas on behalf of the export agents and also speculative traders. At the beginning of the buying season these traders deposit their money to AMCOS accounts

ready for purchase. For the season 2012, the AMCOS found in major growing areas bought between 156 and 300 tons of dry pigeon peas. Opportunities for increasing production and productivity exist. It was found that the quantity bought was less than the quantity demanded by traders. AMCOS were receiving commission in return of buying, storage and loading. The commission varied from 25 to 40 Tshs per kg from one primary society to another. For instance Ruangwa AMCOS collected 25 Tshs per kg as a commission. Export agents and speculative traders then hire trucks from various sources including AMCOS trucks and transfer their consignment to Exporting companies in Mtwara and Dar-es-salaam.

Farmer assemblers were buying on behalf of the speculative traders. Speculative traders bought between 5 and 10 tons per season depending on the capital. In each village were interviews were conducted there were more than 5 traders. These speculative traders were also selling their pigeon peas to directly to exporting companies. The findings revealed that more than 60% of the dry pigeon peas from farmers were sold through assemblers. The major exporting companies found were namely Mohamed Enterprise, PRAYOSA, H.S Impex and Export Trading. These companies were buying pigeon peas in large quantities over 1,000 tons and exporting to India and Dubai. The commission for farmer assemblers was 50 to 100 Tshs per kg. The speculative traders were selling pigeon peas to exporting companies at a price of 600 to 700 Tshs per kg.

Chain 2: Local sale of unprocessed grain

In this chain farmers sell dry pigeon peas to village and also town grain legume retailers. The number of retailers in the market varied from 3 to 6, for instance there was only 3 pigeon peas retailers in Ruangwamarket. Thefarm gate price ranged between 450 to 600Tshs per kg depending on the availability and the retailers' price ranged from 700 to 1200 Tshs the lowest being soon after harvesting and the highest during planting season. Most of the retailers were buying in small quantities of about 100 to 200 kg and hence continued to buy even after the common purchasing season (July to August) ended. This was attributed to fear of storage pests if bought in large quantities, because the major customers were food vendors, restaurants and household consumers who buy an average of 0.5 to 1 kg per day. Actellic super dust was used to control storage pests. A retailer might sell between 0.5 to 1 tons per annum. For instance Mr Jafari Mdoka a retailer at Mangaka market in Nanyumbu district sold 500 kg for the year 2012.

Business is done throughout the year, however, the sales drops during May and June because most of the people starting harvesting green pigeon peas and the market is over-supplied. High demand occurs between December and February; the sales shoot up to 200kg per week. Quality attributes considered during purchasing were mainly cook ability and free from damage. Other competing legumes sold on the table include groundnuts, beans, cowpeas, bambara and green gram. Drypigeon pea seems to be less preferred by consumers to other available legumes.

Chain 3: Sale of fresh pigeon peas

More than 10% of the pigeonpeas produced was soldas agreen fresh vegetable. Farmers were selling green pigeon peas to retailers, door to door traders and also ultimate

consumers. The average price was 200 Tshs per bundle. Retailers were selling to individual consumers, food vendors and restaurants at a price of 300 to 500 Tshs per bundle. It was mainly consumed as vegetable. The findings revealed that most of the consumers preferred green to dry pigeonpeas. This implies presence of niche market opportunity for green peas. However, duration of availability for green pigeon peas is short (about two to three weeks) after maturity. This might be an area of further research to capture this opportunity.

Chain 4: Retention for seed sales

Although more than 60% of the farmers were using reserved seed, others were selling dry shelled pigeon peas to the retailers in the local markets whom become seed sellers during the planting season. Farmers sold at an average price of 400 to 500 Tshs per kg, this was soon after harvesting. While the seed sellers were selling at an average price of Tshs 800 to 1000per kg during the planting season. This is also a viable business opportunity as most of the famers are facing the problem of storage pests.

Chain 5: Local processing for export of dhal

In this chain farmers sold dry pigeon peas to Export trading company agents who established their buying points in the villages or through primary societies. The prices were similar to other traders. After collection the agents transported the consignment to the Export Trading Company (ETC). ETC again transported the consignment to the ETC processing plants in Arusha and Babati. Finally, the processed product 'dhal' are exported to Dubai and India. This trade is currently an insignificant proportion of the total export of Tanzanian pigeon pea – but should grow in future. An unknown, but sizable, proportion of pigeon pea from Northern areas of Tanzania is processed into Dhal in Kenya. We found that most of the dhal from ETC is sold in Dubai which as a different quality profile and price structure to India (see below).

4.4 Structure, conduct and performance of the value chain

The structure of the pigeonpeas business at farm gate was composed of many farmers and buyers. On average about 80% of the farmers in the surveyed areas were growing pigeonpeas and 75% were sold and the rest were consumed either green or dry as bean. In this market structure, the findings revealed that there were freedom of entry and exit in the market and also perfect mobility of the product, but there was no perfect knowledge of the market condition particularly for the farmers. More work is required in this area in order to improve the marketing system and transparency.

Market conduct; there was inadequate market information (prices and market opportunities) particularly for the farmers. Farmers remain the price takers. Traders set price depending on supply and demand within and between seasons. The prices of dry pigeonpeas varied inter-seasonally from 300 to 600 Tshs per kg, a situation that farmers are unable to take advantage of because of poor market information and high post-harvest losses. There was no premium price for quality; the buyers offered the same price regardless of the quality and grade of the produce sold. However, the buyers preferred pigeon peas with cream colour, medium size and also free from waste products. The reasons why traders preferred cream colour and medium size seed are not clearly known. There was no contract farming or

buying arrangements, although soon after harvesting primary societies and speculative traders open their doors ready for purchase.

Performance; the famers share in the value chain was 73% (Table 7). It looks bigger due to the fact that it was calculated from the export agent price and not from freight on Board (FOB) and CIF due to difficulties encountered on accessing FOB and CIF prices.

Gross margin (GM) analyses at farmers' level for 3 competing crops namely pigeon peas, Bambara groundnut and sesame were also done. The data were collected from pigeon peas growing areas and 50 farmers were interviewed for each crop. These GM presents results from farmer practices under local varieties intercropped maize with pigeon peas, maize with sesame and also bambara with maize, cassava or pigeon peas.

The findings revealed that sesame was the most profitable cash crop with a gross margin of Tanzanian shillings (Tshs) 194,300 per acre followed by bambara with a gross margin of Tshs 151,600 and lastly pigeon peas with a gross margin of Tshs 59,160 (Annex 4, 5 and 6). However, there is still a potential for increasing pigeon peas profit margin up to 230,200 Tshs per acre if farmers will be using improved varieties and management practices. Also low producer price was the reason attributed to low profitability for pigeon peas. Apart from exporting companies farmers had relatively high profit margin compared to other actors along the chain.

Table 7 presents pigeonpea selling prices from different nodes along the chain for both dry and fresh pigeonpeas. In the dry peas chain, it was found that the farmers share was 73% and the gross margin was 59,160 Tshs equivalent to 394 Tshs per kg. These figures were relatively high compared to other actors along the chain with exceptional of exporting companies. This implies that farmers were benefiting most compared to other actors along the chain. However, the gross margins at farmers' level might be increased if the farmers will use improved seeds and also good agricultural practices instead of the prevailing traditional practices. The grain retailer/seed seller was another actor with relatively higher marketing share of 58%and gross margin of 300 Tshs. This also might be a good market opportunity for seed stockist. On the side of the fresh pigeonpea marketing chain; there was a niche market for fresh pigeonpeas. Fresh peas were sold at a price of 300 to 400 Tshs per bundle of less than a half kg. It seems relatively more profitable compared to dry peas. The findings revealed that consumers preferred fresh pigeonpeas to dry ones.

Table 7: Pigeon pea selling price in different chains (Tsh/kg/bundle)

Actor	Chain						
	1a	1b	2a	2b	3	4	5
	Export		Local sale of grain		Fresh	Seed	Dhal
	Primary coop	Farmer assembler	Village retailer	Food vendor			
Farmer	500	500	400		200	600	500
Primary cooperative	535						
Farmer/assembler		525					
Speculative trader	650						
Grain retailers			850	700			
Food vendor							
Fresh retailers/door to door				300	400		
Agricultural input suppliers						1000	
Consumer							
Export agents	685						785
Farmers share of final price (%)	72.99						

Notes: as of May-June 2013

4.5 Issues arising from the value chain analysis feeding back into the Southern Tanzania

Interviews and statistics show that Indian consumption dominates world pigeon pea markets and Tanzanian pigeon pea exports reflect this. Interviews with Indian processors were beyond the scope of this study, but review of the literature shows the following important factors that impact on Tanzanian producers. Nevertheless, review of the literature and discussions with exporters gives some insight into the traits preferred by processors and consumers of pigeon pea and dhal in India.

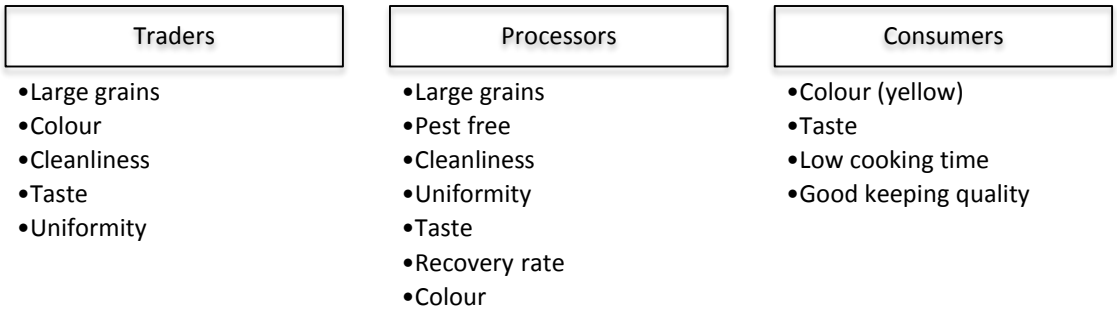
4.6 Indian standards and quality perceptions

There are no quality standards or grades for pigeon pea in Tanzania. In the dry pigeon pea chain visual inspection is the norm and quality parameters such as grain size, colour, conformity, degree of extraneous matter and, particularly, insect damage were mentioned as important factors by all actors in the value chain. Notwithstanding, we found no price differentiation for quality; traders buy all and discount ad hoc. This absence of price differentiation means that farmers are not motivated by quality, but by volume.

A quality premium for East African pigeon pea is often reported in the literature (Shiferaw, Okello et al. 2008 :34), said to be as much as USD50/mt based on size (large) and colour (white) but this was not substantiated by this research.

Deshmukh et al (Deshmukh, Chopde et al. Undated), working in Maharastra and Andhra Pradesh States, says that there are three grades of pigeon pea in India, A – C. The price spread at the time of his research at factory gate was between 2,200 and 2,593 Rupees/quintal[1]. Figure 4 below shows some of the premium parameters identified at trader, processor and consumer levels.

Figure 4: Summary of pigeon pea qualities desired in India



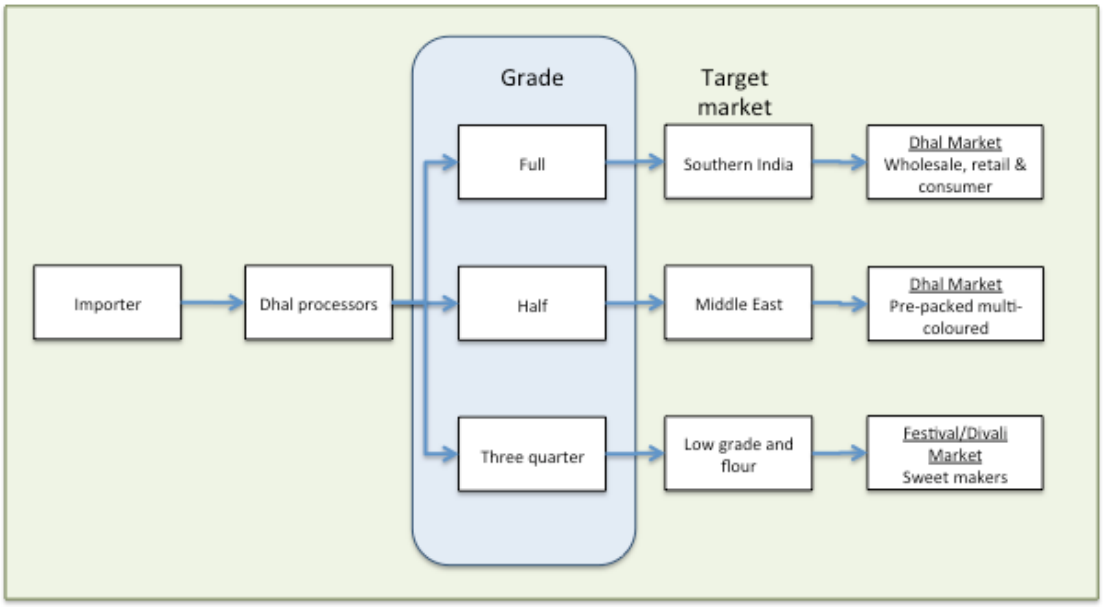
Source: Adapted from Deshmukh et al, undated pp45-50

Dashmukh ranked these quality criteria and attempted to estimate the premium payable. What this seems to suggest is that grain size is important. Unfortunately, the author does not define 'colour' for traders and processors, so we do not know if this means white/cream before decortication or whether it refers to the colour of the dhal. For consumers it seems that a bright yellow seed is important.

Discussions with Export Trading about their dhal export business suggests that there is an important informal grading structure for dhal which may have important implications for which Tanzanian pigeon pea origins get a premium price (or at least get sold first). Within the dhal factory, pre-cleaning removed dirt and foreign matter. This is followed by screening to remove small sized grains. The removal of small grains increases the extraction rate of dhal from seed. Small grains and dust from processing is sold to local poultry producers at a minimal price (e.g. enough to get it out of the factory). Post processing they are left with three grades depending on the size and conformity of the individual cotyledons. These are "full, split and broken". Other chain actors in Babati with knowledge of the Indian market talked about "full, half and three quarter" which are utilised in India and sold to the Middle East in different forms (see Figure 5)

[1]1 quintal = 100kg

Figure 5: Grade and markets for dhal in India – the Tanzanian perception



Source: Trader interview, Babati, 28th March 2013-06-11

4.7 The Indian pigeon pea price structure

India has a system of minimum support prices for pigeon pea (Table 8). This system is intended to provide a floor price at farm gate. At an exchange rate of Rs58.33 to the US dollar this give a minimum price of USD 660/mt.

Table 8: Indian historic Minimum Support Prices for pigeon pea

Year	Rs/mt
12-13	38,500
11-12	32,000
10-11	30,000
09-10	23,000
08-09	20,000
07-08	15,900
06-07	14,100
05-06	14,000
04-05	13,900
03-04	13,600

Source: http://www.theteamwork.com/articles/2016-2072-government-india-minimum-support-price-arhar-tur.html

5.0 Key findings, issues and themes for future research

The following are highlights from the interviews conducted during the value chain analysis.

- Southern Tanzania (and Northern Mozambique) have great potential for increased pigeon pea production

Production of pigeon pea is relatively stable in the North of Tanzania but growing quickly in the Southern Region. This suggests that traders have fully exploited the potential in the North and are now competing for material from the Southern production areas. A improved seeds and relatively small changes in management practices would substantially increase supply.

- Currently there seems to be no in-country premium for quality.

Pigeonpea quality (e.g. size, colour, damage) is not a key determinant of price. Traders are buying everything and no discounts or rejections seem to occur. The literature seems to suggest that these factors are important, but we found very limited evidence from key informants in the value chain to support the 'Babati premium' story. The colour of un-decorticated pigeon pea has no impact on the kernel/seed colour which is universally yellow. Buyers prefer limiting the number of small seeds as these become losses during pre-cleaning. The belief that large seeds sell for a premium seems to be fallacious.

- The absence of Government interference in pigeon pea marketing is a positive

Unlike other Tanzanian cash crop, pigeonpea is not mandated and therefore the market is entirely open. This has substantially increased the range of potential market actors and this is evidenced by talk of numerous direct buying efforts by Indian traders in the harvest season. Many farmers spoke of the benefits of not having to pay government levies on pigeon pea. Notwithstanding, District Councils do attempt to take levies from pigeon pea that is traded through Primary Societies at 5%. The figures collected during this research suggest that District Councils are not being very successful in applying these levies.

- Pigeon pea is a very good inter-crop candidate

In the Southern Region the maize/pigeonpea inter-cropping mix dominates because maize can be harvested before pigeonpea thus extending the harvest income and food availability period. Early results from trials with a pigeon pea – groundnut – maize rotation elsewhere show great promise as a soil enrichment strategy.

- As a cash crop, pigeonpea marketing is largely dominated men with the exception of the fresh vegetable chain where some involvement of women was noted.

Men do all the marketing of dried pigeon pea. However, the hegemony of men in this chain is not universal. We found that the pigeon pea vegetable trade commonly involves women and that some villages specialise in this particular trade [example of Naipingo village in Nachingwea district]. Use of pigeonpea as a vegetable represents a possible niche opportunity, particularly for women in villages close to towns.

- In Southern Tanzania there are no improved pigeon pea production practices (e.g. no improved seed, external inputs or intensive production)

In Northern Tanzania farmers buy uncertified improved seed and spray against pests. This seems to be largely as a result of their more intensive farming system. In Southern Tanzania no external inputs are used for Pigeon pea and currently, no improved seed is available (notwithstanding one medium maturing variety, ICEAP 00557, developed by ARI Naliendele which is undergoing on-station and on-farm trials but has not yet been released officially)

- In chain and policy level interviews show that there is no support to pigeon pea on Southern Tanzania

Almost no support has been given to pigeon pea farmers by extensionists in the South and pigeonpea has not been taken up by any NGOs. A clear and simple package of improved locally appropriate seed and agronomic practices is needed.

- The market prefers not to have small seeds, but otherwise all varieties are accepted

The hypothesis that Babati seed is somehow a premium product because it is white is misleading. It seems that absence of extraneous matter, ease of decortication and quality of splitting are the key quality drivers, but this is achieved by not having small seeds rather than paying a premium for larger seeds. New varieties that meet this size criterion can also be acceptable for export and processing into dhal.

- Almost nobody in Southern Tanzania uses pigeon pea by-products for animal feed.

In Southern Tanzania pigeon pea waste (leaves, stems and pods) are not used and this represents an important, but underutilised, potential source of supplementary animal feed. In Northern Tanzania trade in this waste material exists in all areas.

- Currently there are two lead actors in Tanzania in the pigeon pea export sector.

Lead actors in value chains set market conditions. Interviews with Primary Cooperatives in Southern Tanzania had suggested to the Team that there were many exporters being supplied by a large number of speculative pigeon pea traders. On validation we found a) that many of the traders registered by cooperatives have fallen out of the market and their retention in the memory is, to some extent, wishful thinking (e.g., all Primary Cooperatives said that OLAM are regular buyers but OLAM say that they stopped buying several years ago). The pigeon pea lead actors in Tanzania seem to be Export Marketing and Mohammed Enterprises (e.g. the actors that set market conditions and dominate its governance). These lead actors are multi-nationals, able to benefit from applying sophisticated commodity market instrument to even out risk (e.g., future trading, currency hedging and transfer pricing between markets). Lead actors that have fallen out of the pigeon pea market in Tanzania told the Team that they are unable to compete with these two lead actors.

- Post-harvest losses for pigeon pea are very high and this forces early sale

Produce ear-marked for sale is sold immediately due to high susceptibility of pigeon pea to storage pests. Grain kept for household consumption is usually retained in-pod to reduce

attack and threshed on demand. Farmers use Actellic to preserve seeds, but new, cost effective, on-farm storage strategies is needed.

6.0 Recommendations

The value chain analysis shows that there is strong and unsatisfied demand for pigeon pea from Southern Tanzania for processing into dhal in India. This increased demand is currently being met by increased production area, but could be met more efficiently by improvement in productivity.

We recommend development of new seed varieties and improved agronomic practices appropriate for both farmers and market needs (including improved inter-cropping recommendations).

The quality story in Tanzania is opaque. There seems to be a notional premium for large, cream coloured seeds, but the research suggests that this is not easily realisable by farmers. Reducing the number of small seeds would be an advantage to dhal processors. A cream colour of whole seed would allow traders to clearly differentiate improved varieties from traditional ones in the market and this could lead to a premium. Application of standards to pigeon pea would be a bit pointless as the main buyers (India) do not differential quality at point of import.

We recommend that breeding focus initially on increasing productivity, reducing the proportion of sub-sized peas. Varieties that are easy to differentiate in the market may get a premium at some future point, but this is not guaranteed.

Currently Tanzanian Government policy over-looks pigeon pea and this is perceived as an advantage by most actors.

With the exception of supporting research and improved production practices, we recommend that the Government of Tanzania continue this non-interference policy for pigeon pea.

To date, breeders in Tanzania have ignored the role that pigeon pea by-products could play in farming systems as a supplementary feed source during the dry season. Increased pigeon pea production in Southern Tanzania allied to a growing animal population suggests that much more could be done to encourage on-farm utilisation of this resource.

We recommend that NARI work with the Tanzania Livestock Research Institute to develop suitable recommendations on pigeon pea by-product utilisation as livestock feeds.

Farmers are forced to sell pigeon pea almost immediately after harvest because pest damage during storage is substantial. Traders and exporters incur high storage costs due to excessive pest loads on pigeon pea delivered from farmers' stores. Grain retained for food security appears to be heavily infested in home stores and may suffer substantial physical loss which translates into a nutritional shortfall for households

We recommend that a programme of research into appropriate and viable pigeon pea storage practices and techniques be initiated. New practices in the grains sector may be

appropriate for pigeon and should be tests e.g., triple bagging, improved sun-drying, and improved traditional stores.

Efforts to understand the farm economics conducted during this research showed that pigeon peas is a viable enterprise although its profit margin was low compared to other competing crops like sesame and bambara. This was attributed to relatively low selling prices and also productivity per unit area.

We recommend that, research through breeding program to develop and disseminate high yielding varieties and also accompanied with improved agronomic practices. This should include the fast-track release of existing new varieties such as ICEAP 00557 and the initiation of on-farm certified seed production with farmer groups.

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Appendices

1: Gross margin questionnaire

PIGEON PEAS GROSS MARGIN

FARM BUDGET SURVEY QUESTIONNAIRE (ICRISAT PROJECT)

Date of interview (dd/mm/yyyy)……2. Enumerators' name……..

A. Farmer and site identification

1. Farmer (respondent) name…..……

2. Region.....3. District…….

4. Ward……...5. Village……

1. Mention important cash crops in order of importance? 1.....

2..... 3. ..... 4.....

A. Gross Revenue accrued from the crop

1. Do you grow pigeon peas? Yes/No.

2. If yes which crops did you intercrop with pigeon peas in the last season?

1..... 2..... 3.....(***Interview farmer intercropping maize and pigeon peas only***)

3. Do you grow local or improved varieties?.....(***continue if farmer grow local varieties***)

How much pigeon pea did you produce last year?..... (Kg) if bag (specify.....)

4. What area did you plant to pigeon pea?..... (acres)

5. What proportion consumed at home? .....

6. How much amount (kg) sold.....

8. at what price per kg.....

9. What are the uses of stems and pods after harvesting? (i) Animal feeds (ii) Burnt (iii) left in the field (iv) Sold

10. If sold at what price and quantity? .....Tshs/kg; .....Tshs/bag; .....

others (specify)

B. Variable costs incurred during production process

B1. Non-labour inputs costs

1. What was the land cultivation cost per acre ?.....
2. Total amount of seed used last season? ..... kg
3. Source of seed (i) Recycled (ii) Bought
4. If bought where? (i) local market (ii) farmers (iii) Research (iv) others (specify).....
5. What was the price of seed per kg?.....
6. Type of seed planted last season (i) improved (mention.....(ii) local (mention.....) (iii) Both, if both what proportion of improved?.....
7. What was the planting cost per acre?.....
8. What was the cost of thinning and gap filling?.....
9. Did you apply fertilizer on pigeon peas? Yes/No
10. If yes what type of fertilizer applied?.....
11. What was the quantity applied to the whole farm?.....area (acres).....
12. What was the price of fertilizer? .....
13. What was the fertilizer application cost? (labour cost).....
14. Did you apply PESTICIDES on pigeon peas? Yes/No
15. If yes what type of pesticides applied?.....
16. What was the quantity applied to the whole farm?.....area (acres).....
17. What was the pesticides application cost? (labour cost).....
18. What was the price of pesticides? .....
19. What was the weeding cost per acre?.....
20. How many times did you weed the farm? (i) Once (ii) Twice (iii) Thrice
21. What was the harvesting cost per acre?.....
22. What was the transport cost from the field to the home stead?.....(per kg, bag, bucket)
23. What is the threshing cost per bag? Bucket?.....(specify kg)
24. How many bags did you use for packaging last season?.....
25. What was the price per bag?.....
26. What was the amount of sisal twine used?.....
27. What was the value of sisal twine?.....
28. Do you store pigeon peas? Yes / No
29. I f yes for how long? ..... (months)
30. How do you solve the problem of storage pests?.....
31. Where do you store pigeon peas for home consumption and seed?.....

32. Do you apply storage pesticides? Yes/No

33. If yes mention storage pesticides.....

34. What was the price?.....

35. Where do you sell the pigeon peas? (i) Agents (ii) Middlemen (iii) Co-operative society (iv) local traders (v) Fellow farmers.

36. What qualities do buyers prefer? (i) size (ii) cleanliness (iii) colour (iv) undamaged (v) others (specify)

37. What was the transport cost from home stead to the market?..... (per kg, bag, bucket)

B2. Labour input

Activity	**Number of people**	**Number of days spent**	**Average number of hours spent @ day**
Clearing of field			
Cultivating (hand hoe)			
Harrow			
Ploughing, harrow (tractor)			
Planting			
Thinning & gap filling			
1st weeding (hand hoe)			
2nd weeding (hand hoe)			
Fertilizer application (labour)			
Manure application labour			
Insecticides spraying (labour)			
Harvesting (labour)			
Transport from field(labour)			
Threshing (labour)			
Winnowing (labour)			
Packaging (labour)			
Transport to the market (labour)			

END

THANK YOU FOR YOUR CO-OPERATION

3: Draft Guide Questions

a. Farmers

How much pigeon pea did you produce last year?
What area did you plant to pigeon pea?
Did you inter-crop?
What crops with you inter-crop with pigeon pea and in what proportion?
Where did you get seed?
How much seed did you need per ha?
Did you use any fertilizer or pesticide?
How much of your production was consumed on-farm?
Did you sell straight away after harvest or did you store?
Who did you sell to and where?
What price did you sell for?
What were the selling arrangements?
What qualities do the buyers prefer?
What reasons do the buyers give for discounts or deductions?
How do you store pigeon pea and what problems do you experience with storage?
What did you do with the crop residue and pods?
How often do you consume pigeon pea?
How much labour doe'spigeonpea use compared with other crops?
Who does the different farm activities (clearing, planting, weeding, harvesting, drying, threshing, sorting, and selling)?
How much of the crop is eaten green?
What is the crop production schedule (months)?
How do you consume pigeon pea?
What are the advantages of pigeon pea over other possible crops?
What problems do you experience with pigeon pea production?

b. Trader questions

Do you buy pigeon pea?
How much pigeon pea did you buy last year?
Who did you buy from?
What price did you pay for pigeon pea?
Did you get all the pigeon pea that you wanted?
What qualities are preferred in pigeon pea?
What are the costs of transporting pigeon pea?
Do you store pigeon pea?How long do you store it?
What losses do you incur?
What is the cost of storage?
Who do you sell to?
What is the price range when you sell?
What qualities affect the price when you sell?
How do you finance your buying (do you take loans – what interest rate)?
Do you offer any services to sellers or buyers (e.g. credit, bags, and loans)?
How are payments to farmers arranged?
Do you process, sort, clean, dry or pack pigeon pea? What other products do you trade?

4: Pigeon peas gross margin analysis

1. Gross income		**Farmer practice under local varieties**			**Farmer practice under improved varieties**		
Item	**Units**	**Quantity**	**Unit price (Tshs)**	**Amount (Tshs)**	**Quantity**	**Unit price (Tshs)**	**Amount (Tshs)**
Crop Yield	Kgs/acre	150	517	77,550	600	517	310,200
Total gross income	**Tshs**			**77,550**			**310,200**
2. Variable costs							
(a) Input costs							
Cultivation	acre	1	0	0			
Seeds	Kgs/acre	3.8	1050	3,990	8.8	3000	26,400
Planting	acre	1	0	0			
1st weeding	acre	1	0	0			
2nd weeding	acre	1	0	0			
Pesticide	litre	0.5	20,000	10,000	1.6	20,000	32,000
Pesticide application cost (labour cost)	acre	1	0	0			
Harvesting	acre	1	0	0			
Transport from field to homestead	Bag	5	0	0			
Threshing and packing	Bag	1	0	0			
Transport from home to the market	Bag	2	1000	2000	12	1000	12000
Packaging materials	Bag	3	800	2400	12	800	9600
Subtotal (a) non labor input cash costs	Tshs			**18,390**			**80,000**
(b) Labor inputs							
Activities	**acre**	**Total hours spent**	**unit manday (hrs)**	**Mandays**			**Mandays**
Land preparation	**acre**	226.48	8	28			28
Planting	**acre**	40.84	8	5			10
Thinning and gap filling	**acre**	19.66	8	2			2
*1st Weeding (Hand weeding)	**acre**	115.38	8	14			16
2nd weeding (hand weeding)	**acre**	126.00	8	15			16
Pesticide application cost (labour cost)	**acre**			4			4
Harvesting	**acre**	81.33	8	10			16
Threshing and winnowing	**acre**	49.37	8	6			10
Transport to market	**acre**	3.84	8	1			1
Subtotal of (b) labour mandays				**85**			**103**
NET INCOME/GROSS MARGIN PER ACRE	**Tsh/acre**			**59,160**			**230,200**

NET INCOME/manday				693.468			2234.95

Assumptions/remarks
Farmers were growing local varieties.
Traditional farm management practices were used.
Farmers intercropped pigeon peas with maize.
Family labour were used to most of activities such as land cultivation, planting, weeding, pesticides application, harvesting, transporting the produce from field to homestead and threshing and winnowing.
One man day was considered as 8 hours of working in the field.

Annex 5: Bambara gross margin analysis

1. Gross income		**Farmer practice under local varieties**			**Improved practices under improved varieties**		
Item	**Units**	**Quantity**	**Unit price (Tshs)**	**Amount (Tshs)**	**Quantity**	**Unit price (Tshs)**	**Amount (Tshs)**
Crop Yield	Kgs/acre	153	1200	183,600	600	1200	720000
Total gross income	**Tshs**			**183,600**			**720000**
2. Variable costs							
(a) Input costs							
Cultivation	acre	1	0	0			0
Seeds	Kgs/acre	9	0	0	32	3000	96000
Planting	acre	1	0	0			0
1st weeding	acre	1	0	0			0
2nd weeding	acre	1	0	0			0
Harvesting	acre	1	0	0			0
Transport from field to homestead	Bag	6	0	0			0
Threshing and packing	Bag	6	4500	27000	36	4500	162000
Transport from home to the market	Bag	2	1500	3000	12	1500	18000
Packaging materials	Bag	2	1000	2000	12	1000	12000
Subtotal (a) non labor input cash costs	Tshs			**32,000**			**288000**
(b) Labor inputs							
Activities	**acre**	**Total hours spent**	**unit manday (hrs)**	**Mandays**			
Land preparation	**acre**	247	8	31			31
Planting	**acre**	209	8	26			30
Thinning and gap filling	**acre**	66	8	8			5
*1st Weeding (Hand weeding)	**acre**	274	8	34			34
2nd weeding (hand weeding)	**acre**	249	8	31			31
Harvesting	**acre**	362	8	45			45
Threshing and winnowing	**acre**	163	8	20			25
Transport to market	**acre**	24	8	3			3
Subtotal of (b) labour mandays				**199**			**204**
NET INCOME/GROSS MARGIN PER ACRE	**Tsh/acre**			**151,600**			432000
NET INCOME/manday				**761**			2117.647059

6. Sesame gross margin analysis

1. Gross income		**Farmer practices under improved varieties**		
Item	**Units**	**Quantity**	**Unit price (Tshs)**	**Amount (Tshs)**
Crop Yield	Kgs/acre	180	1300	234,000
Total gross income	**Tshs**			**234,000**
2. Variable costs				
(a) Input costs				
Cultivation	acre	1	50000	0
Seeds	Kgs/acre	1.5	3000	4500
Planting	acre			0
1st weeding	acre			0
2nd weeding	acre			0
Pesticide	litre	0.5	20,000	10000
Pesticide application cost (labour cost)	acre			0
Harvesting	acre			0
Transport from field to homestead	Bag			0
Threshing and packing	Bag	9	2000	18000
Transport from home to the market	Bag	4	1000	4000
Packaging materials	Bag	4	800	3200
Subtotal (a) non labor input cash costs	Tshs			**39,700**
(b) Labor inputs				
Activities	**acre**			**Mandays**
Land preparation	**acre**			29
Planting	**acre**			7
Thinning and gap filling	**acre**			12
*1st Weeding (Hand weeding)	**acre**			18
2nd weeding (hand weeding)	**acre**			18
Pesticide application				1
Harvesting	**acre**			13
Threshing and winnowing	**acre**			4
Transport to market	**acre**			1
Subtotal of (b) labour mandays				**103**
NET INCOME/GROSS MARGIN PER ACRE	**Tsh/acre**			**194,300**
NET INCOME/manday				1886.408

Note: Farmers were intercropping sesame with maize of sorghum.

Annex 7: Pigeon peas production and marketed volumes in some of districts in South-eastern Tanzania.

Table1: Volume of pigeon peas (tons) produced in some of districts in Lindi and Mtwara regions

Year	Lindi urban	Masasi	Nanyumbu	Ruangwa	Lindi Rural
2011/12	2622	21479	11,200	8366.5	16,086
2010/11	3188	25136	10,586	6682	14,093
2009/10	1411	7800	9,090	4674	4,455
2008/09	810	83265		4914	5,180

Table2: Volume of pigeon peas (tons) marketed in some of districts in Lindi and Mtwara regions

Year	Nachingwea	Masasi/Nanyumbu	Ruangwa	Lindi
2011/12	7666	1321	1601	73.40
2010/11	4098	833	1502	172.50
2009/10	5265	1198		261.70
2008/09	898	330		277.77