

ASSESSMENT OF CROP BASED FARMING SYSTEMS WITH A FOCUS ON PIGEONPEA IN ONE SELECTED DISTRICT IN ARID AND SEMI-ARID LANDS IN THE KENYAN COAST.

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Abstract

A diagnostic farm survey was carried out in Mwachabo sublocation, Mwatate division, Taita-Taveta district of Kenyan Coast to establish the current status of pigeonpea production, farm level utilization and marketing. Taita-taveta district has upto 85% of its land being classified as arid and semi arid (ASAL). About 80% of the population is found in the ASAL. A global participatory rural appraisal (PRA) was carried out covering community map, transect, timeline, livelihood mapping, trend lines with respect to rainfall and legume production trends, land allocation with respect to crop production and finally focussing on pigeonpea.

In Mwachabo sub-location, famine was noted to be a very common phenomena in the area due to drought. According to the inhabitants bumper harvests have not been observed since the 1950s upto the present. The area experienced a severe drought in 1993 and 1996. Maize usually occupies 70% of the farm land but does not yield well due to drought. In this area pigeonpea was not rated amongst the top five crops yet it is widely consumed. The district as whole imports, via Taveta, from Tanzania about 1000 tons per month of pigeonpea some of which is eaten in Taita-Taveta district. The balance is sold to the Kenyan coastal towns where there is a ready market. The little dry pigeonpea produced in Mwachabo is either consumed by the family or marketed. The families utilize green pigeonpea.

The main constraints identified with respect to pigeonpea during the survey were lack of improved cultivars, seed for planting, field and storage pests, fusarium wilt, poor-roads, lack of ready markets even if farmers were to produce, high cost of pesticides, lack of improved agronomic practices, limited uses of pigeonpea and drought. The community came up with community action plans some of which could be implemented immediately. Four different improved pigeonpea cultivars were introduced to farmers who were trained from production to utilization. Farmers selected six seed producers for the same cultivars so that high quality seed would be available within the area. These farmers underwent training as seed producers and their fields monitored frequently.

By September 1998, a year since the PRA was conducted the farmers harvested at least 100kg dry grain, from the free 1kg supplied, and they have had buyers with lorries to purchase both dry and green pod pigeonpea. Each family should have harvested at least 200kg of dry grain of pigeonpea depending on the technology package they received. This particular program will continue.

1. INTRODUCTION

Kenya is divided into six agro-ecological zones based on rainfall and moisture indices. In this classification, zone I is the wettest and zone VI is the driest. Arid and Semi-Arid Lands (ASAL) covers zones IV, V and VI with a mean annual rainfall ranging between 200 to 800 mm and a moisture index of - 57 to 30.

These areas cover 473,000 Km² (82% of Kenya's land area) and can be grouped as follows:-

- (1) 10% of zone IV (Semi-arid) with an area of 58,000 km sq, rainfall range of between 500 and 800 mm/year and moisture index of between - 30 and - 42.
- (2) 49% of zone V (arid) with an area of 283,000 km sq, rainfall range of between 350 and 500 mm/year and moisture index of between - 42 and - 51.
- (3) 23% of zone VI (very arid) with an area of 132,000km sq, rainfall range of between 200 and 350 mm/year and moisture index of between - 51 and - 57.

The ASAL districts of Kenya have been ranked into four categories and Taita-Taveta district falls under category B where 85% of the land area is composed of zones IV, V and VI and have a 80% of the districts population. ASAL in the district is located in the lowlands. Agricultural activities mainly livestock production dominate the ASAL economy. While crop farming covers maize, sorghum, cassava, beans and cowpeas crops with pigeonpea crops grown at terrace benches to stabilize the terraces. Crop farming is greatly affected by weather hazards such as drought or unreliable rainfall, unavailability of drought tolerant crop cultivars, wild life menace among other constraints. Food insecurity characterized by frequent famine is very common in this area.

Pigeonpea is an important drought tolerant legume in Eastern province and to a lesser extent, Central and Coast provinces of Kenya (Omanga, Kimani and Nzuva, 1986). In the late 1980's the area and annual production was estimated at about 100,000 ha and over 50,000 tons respectively. Over 95% of this production is in the semi- arid districts of Eastern province where the crop, with 17-28% protein content, is an important source of protein in the diet and cash income for resource poor households (Mbatia and Kimani, 1991). It is important to note that while 95% of pigeonpea is grown in Eastern province the local markets for dry grain pigeonpea are in the Coast province where the grain is boiled and mixed with roots of tuber crops or green bananas or pound dry maize. The resultant foods are known as Kimanga and pure. In coastal towns the dry grain of pigeonpea is boiled in coconut extract and forms part of the breakfast in homes or in local hotels. Thus, the Coast province provides the local markets and highest points of utilization for dry grain pigeonpea although the cultivation of the crop is less than 5% of the total grown in Kenya. However, export markets for this crop exist both as processed and unprocessed dry grain or as green pods (Ndambuki, 1991).

This work was initiated with the following objectives:-

- (1) Describe the farming systems in which pigeonpea is amongst the legume crops.
- (2) Establish factors which explain the variation in farming systems where pigeonpea forms part of the crop legumes.
- (3) Identify factors which influence adoption of improved practices in pigeonpea production.
- (4) Determine major pigeonpea production, utilization and marketing patterns and trends as well as the causes of the variation.

2. METHODOLOGY

After reviewing secondary information available and discussions with extension staff of Ministry of Agriculture, Livestock development and Marketing (MOALM), sublocation where pigeonpea is one the legume crops grown and has a high potential, are not cultivating it very intensively, was identified. The sublocation identified was Mwachabo in Mwatate division. A survey of two weeks was held with the local community of Mwachabo. The survey was subdivided into one week of Participatory Rural Appraisal (PRA) and one week of individual household interviews using a semi-structured questionnaire.

2.1 Participatory Rural Appraisal/Approach (PRA)

The main objective of this approach is to collect and analyze information from rural communities in a very fast way through interaction (Lelo *et al.* 1995).

The following were some of the important reasons why PRA was used:-

- (a) In PRA, problems are identified by farmers themselves
- (b) Results of PRA are also owned by farmers/community
- (c) In PRA, farmers decide how to get the information, how to formulate solutions and even projects.

2.1.1. PRA Team Composition

The composition of the PRA team included all disciplines in crop production and utilization. The participation of local chief and elders was crucial for the mobilization of farmers to attend the public meeting (locally known as baraza).

2.1.2. PRA Training Session

A one day training session was held at Kibwezi irrigation project, University of Nairobi. This was carried out so that the PRA team could be brought to the same level with respect to the survey to be conducted. The participants were exposed to the different PRA tools.

2.1.3. Launching of PRA

The PRA itself took 4 working days each lasting 8 hours but including tea and lunch breaks. The PRA was launched with the assistance of the District Officer (administrator) and local chief. The launching ceremony was held at the chief's office compound. PRA was held in group discussions. The actual PRA started immediately, after a brief presentation of the objectives of the meeting, with the community sketch map and time line of the community. These exercises permitted the warm-up of the farmers and helped the PRA team to know the history and the spatial dimensions of the community.

The main PRA tools used by the community and the PRA team to gather and analyze data were time trends, transect, daily gender calendars, livelihood diagram, venn diagrams, seasonal calendar, problem listing and analysis, problem ranking and opportunity or options assessment through development of community action plans (CAPS). During PRA pigeonpea utilization was demonstrated by a farmer from Makueni district, Eastern province who had been trained by ICRISAT in India.

2.1.3.1 Household interviews using Semi-structured Questionnaires

This was necessary in order to capture any details or salient information on pigeonpea which might not have come out well during PRA. A simple random sample of 48 farmers was selected for single-visit interview using a semi-structured questionnaire. Six villages in Mwachabo sublocation were randomly selected from the total of thirteen. Afterwards, eight households were randomly selected in each village. The household interviews were conducted by eight teams of two people with one person speaking local language.

A single questionnaire had 20 pages with predefined questions and answers. Time to fill in a questionnaire ranged from 50 minutes to 3 hours with an average time of 1 hour and half. Analysis of household interview questionnaires was made using Microsoft Excel. Statistical analysis only consisted in the establishment of distributions of frequency and was always based on the accurate number of answer for each question.

2.1.3.2 Pre - extension trials (PETS)

In total 160 farmers were involved in the pre-extension trials. These farmers were randomly selected during PRA using the PRA list which had over 300 attendants.

Three pigeonpea production technologies were selected and included:-

1. Short duration pigeonpeas grown as a mono-crop by 80 farmers and each received:
 - (a) cv. ICPL 87091 - 1kg
 - (b) cv. NPP 670 - 1kg
2. Medium duration pigeonpeas grown as a monocrop by 40 farmers and each received:
 - (a) cv. Kat 60/8 - 1kg
 - (b) cv. ICP 6927 - 1kg
 - (c) cv. ICEAP 00068 - 1kg.

The PETS farmers were trained separately according to technology to avoid confusion in production packages. The training covered land preparation; planting with great emphasis on spacing as these new cultivars have very close spacing; weed control; insect pest control using pesticides; *fusarium* using cultural control measures; harvesting; threshing and storage insect pests control.

2.1.3.3 On-farm Seed Production

Availability of high quality seed in the ASAL is a major production constraint as seed companies neglect the ASAL farmers needs due to their low buying power. This was also revealed as a major constraint during PRA. The farmers resolved to tackle this constraint by producing seed at village level. During PRA the farmers elected 6 pigeonpea seed producers each from one of the six villages using the criteria provided by the PRA team.

The selected farmers had to allow farms to be used as demonstration plots; have access to spray pumps for control of insect pests and on harvesting sell the seed to farmers participating in PRA at reasonable price. Each farmer bulked one genotype. Seeds of

cultivars namely ICPL 87091, NPP 670 , ICP 6927, ICEAP 00068 were bulked. Each farmer received 10kg of seeds treated with fungicide (benomyl).

All the six seed producers were trained in seed production and provided with insecticide for control of pod borers, pod fly and pod sucking bugs. Their fields were routinely inspected for off types and *fusarium* wilt and also used as demonstration plots for other PRA farmers.

3. RESULTS

3.1 Community Sketch Map

According to the sketch map draw by the community, Mwachabo sub-location covers an area of about 24 km in length and 6 km in width with 13 villages. The region has several scattered hills with six earth roads. Water in the sublocation is supplied by seasonal dams which dry up during dry months of the year.

3.2 Transect

Soils in the sub-location are mainly red sandy - loams. The vegetation is composed of natural bush with few newly introduced trees (both ornamental and leguminous trees). On the hilly areas, vegetation is sparse living bare soil which is susceptible to erosion. Other noticeable problems are overgrazing and deforestation. Farming systems are mainly mixed-farming. Livestock rearing is an occupation in this area. Maize is cultivated in both pure stand and in mixed-cropping with legumes (beans, cowpeas, green gram, *Lablab purpureus* and pigeonpea), cassava, castor and simsim. It was observed that the area under legume crops was minimal and this was due to successive droughts which have led to lack of seeds in all crops except maize.

3.3 Time Line

The first settlers into the area came before the beginning of this century from the Taita-hills . Main crops at the time were sorghum, millets, maize, green gram, cowpea, pigeonpea, *Lablab purpureus* and sweet potatoes. Crops like cassava, improved maize varieties cv. NPP 670, the short-duration pigeonpea variety ,were introduced later. Famine is very common in the area due to drought. High yields have not been recorded in this area since the 1950's and 1960's.

3.4 Livelihood Mapping

Pigeonpeas, cowpeas, green grams, beans, *Lablab purpureus*, maize, sorghum, millets and milk are produced in Mwachabo sublocation but not in sufficient quantities especially in drought years. In the same area mangoes, sweet potatoes, hot pepper, pawpaws, cassava and citrus are grown although not intensively. The rest of the other foods come from outside the area.

3.5 Trend Lines

The farmers also drew their rainfall and legume production trends in Mwachabo.

(a) *Rainfall trend*

Mwachabo sub-location experiences very regular droughts. According to the rainfall trend line and through discussions with the farmers annual rainfall seems to be on the decline from year to year.

(b) *Legume production trends*

The legumes, ranked by importance by the community, are beans, cowpeas, green grams, pigeonpea and *Lablab purpureus*. Cowpeas have been the most important legume in the area for many years before starting to show a decline in recent years. Bean production was rated as fair from 1940 to 1966 and thereafter its yields have been low and very inconsistent. Pigeonpea production started from a very level in 1940. However, this legume has shown to be much better in yields in the recent years, which have recorded low rainfall, when compared to beans and cowpeas. Despite this favourable observation for pigeonpea, the acreage under this crop is still limited.

3.6 Venn Diagrams

Venn diagrams were drawn by the community for land allocation, source of pigeonpea seed, marketing and consumption of pigeonpea products and the relative importance of crops and livestock in the area. Maize is the most important crop with 70% of the farm land allocated to this crop. Beans, green grams, cowpea, pigeonpea, and other crops occupy 8%, 5%, 5%, 4% and 8% of the remaining farm land respectively. Pigeonpea green pods are mostly consumed by the family and very little is sold while most of the dry grain of this crop is marketed immediately after harvesting.

The source of pigeonpea seed in the area is very diverse. Most farmers use their own seeds kept from previous harvest. Some farmers do purchase from neighbors or relatives. While in years of seed scarcity, which is usually after a severe drought, non- governmental organizations and the government provide the seeds.

3.7 Seasonal Calendar

Rainfall in Mwachabo is bimodal occurring from March to June and October to December. Land preparation is usually done before the onset of rains. Pigeonpeas are usually planted in October. Weeding is done as many times as is necessary but starts two weeks from planting. Insect pests become a serious problem in pigeonpea from beginning of June upto end of August while Fusarium wilt incidence is recorded from May. Green pods are available in July and thereafter the crop dries. Dry grain harvesting begins in August upto end of September. Storage of dry grain is almost non-existent in this area due to high incidence of storage insect pests. The dry pigeonpea is sold immediately after harvesting.

3.8 Problems listing and ranking

Problems were listed and ranked by the community. The most important pigeonpea production problems in Mwachabo, by order of importance were listed as: Lack of improved cultivars, lack and high cost of pesticides, lack of planting seeds, field insect pests (pod sucking bugs, pod borers, pod flies, scales, aphids, termites, hoppers, blister beetles), storage insect pests (bruchids), lack of improved agronomic practices, poor infrastructure, drought, diseases (Fusarium wilt, Cercospora leaf spot, powdery mildew), limited uses of pigeonpea and wildlife (elephant) damage in July to September when the animals move about in search of water.

The farmers again handled each problem individually, analyzed the causes, available coping strategies and opportunities for each problem. In line with the pigeonpea program the farmers identified introduction of drought tolerant or drought escaping varieties and training on improved pigeonpea production practices, pigeonpea products utilization and seed production as being crucial in adoption of pigeonpea in this area.

3.9 Pre-extension trials and seed production

During PRA well over three hundred farmers participated in this exercise. However, only 160 farmers were randomly selected to participate in pre-extension trials. The farmers were clustered into village groups and each pigeonpea technology targeted 4 villages with each village having 10 farmers and 20 farmers in line with technologies 2 and 3 and 1 respectively. Overall evaluations brought together the pre-extension trials and seed production farmers.

In Mwachabo the El Nino rains turned to be very useful in that maize yields and pigeonpea were at their best. While other legumes such as beans, cowpeas, green grams were damaged by the rains as they rotted away at maturity due to heavy rains. The heavy rains encouraged vegetative production, caused flower abortion thus delaying pod set in pigeonpea cvs NPP 670, Kat 60/8, ICP 6927, and ICEAP 0006. While cv ICPL87091 behaved true to type by maturing in 3 ½ months although where the farmers delayed in harvesting the dry pods became mouldy and rotted away due to heavy rains. The heavy rains experienced from October 1997 to May 1998 giving an average of 1800mm while under a normal year the average are between 200- 500 mm/year greatly influenced the spraying programs. The majority of the farmers abandoned the spraying of insecticides after 3 or 4 sprays as the pod set never seemed to occur except in cv. ICPL 87097. At the onset of warm dry weather in May 1998 the extraordinary bushy and tall pigeonpea flowered heavily followed by heavy podding. The majority of the farmers never resumed spraying. The farmers noted that insect populations seem to have declined as the dry weather set in and this seemed to have been advantageous to the podding pigeonpea. The farmers reported high yields except in cv ICPL 87091 which is a much smaller plant. In the case of cvs NPP 670, Kat 60/8, ICEAP 00068, ICP 6927 for every kg planted the farmers reported average dry grain yields of 130-150 kg and for farmers who sprayed in the month of May and June 1998 the yields were 180 to 200 kg. The farmers reported eating of green pigeonpea and even selling in urban centers located 20 to 30 km away.

The farmers were also asked to list the positive and negative qualities by variety. The negative qualities included susceptibility to *fusarium* wilt, insect pests (both field and storage) and the recommended close spacing for pigeonpea is not compatible with insecticide applications. The positive qualities included high yields, long pods, large seeds easy shelling of green pods, fast cooking, taste, early maturity and long period of availability of green pods for food and marketing. Early maturity was associated with cv ICPL 87097 (code named by local farmers as cv. "Kafupi") as the continuous rains affected flowering/podding in the other varieties. High yields applied to all cultivars including cv. ICPL87091 where farmers applied insecticidal sprays and harvested on time. Long pods, large seeds and easy shelling of green pods qualities were noted for cvs NPP 670 and ICEAP 00068. Cv ICEAP 00068 was noted for its fast cooking for both green and dry grain. The green grain of cv ICEAP00068 cooked in half hour and described to be very tasty to eat.

The good taste was also noted in the dry grain. Cv. Kat 60/8 was noted to be very difficult to shell when green as the seeds seemed to be individually sealed off by a large gap in between the seeds. However, the cultivar was noted to have had the longest period of green pods as it seems to have flowered continuously giving young, mature and dry pods at any one time. Small seeds were noted in cvs ICPL 87091 and Kat 60/8 and the merchants buying dry grain paid less for this type of seed compared to the higher prices paid to the large and bold dry grain of cvs ICEAP 00068 and NPP 670 (code named as cv ufangio).

In Mwachabo area during PRA, farmers noted lack market outlets as a major problem. However, on harvesting pigeonpea they reported that traders have come in with trucks to purchase pigeonpea from as far as Mombasa which is about 150 km away. A trader has even rented local premises to purchase and store pigeonpea. The farmer noted that pigeonpea was tolerant to El Nino rains as it was the only legume which survived the heavy rains resulting in high yields. They resolved to grow all the cultivars in the area as each has different attributes. For instance cv ICPL 87091 seeds might not be able to fetch high market price but is good for food security as it matures very early (3 - 3 ½ months). Lack of sprayers due to high costs, lack of water and low prices for dry grains are currently considered very important factors which will greatly influence pigeonpea production in the coming years.

4. DISCUSSION

The PRA and household interviews show the cultivation of pigeonpeas in Mwachabo sublocation in Mwatate division of Taita-Taveta is not developed as less than three quarters of the farmer participants cultivate the crop. These farmers mainly planted local long duration pigeonpea varieties in the traditional cropping system. The planting consisted of one row of pigeonpea plants in between upto 15 rows of pure maize or sorghum giving an inter-row spacing of upto 20m. Intra-row spacing of pigeonpea plants could be upto 10m. Pigeonpea was reported during PRA as the less yielding legume compared to cowpeas, green pods and beans and thus less land was allocated to this legume. The yields reported from the traditional pigeonpea were on average as low as 70kg/ha with actual dry grain yields of about 10-20 kg/farmer. They however, still reported pigeonpea as an important

crop for food security but not for marketing. This is interesting observation as 95% of pigeonpea production in Kenya is in Eastern province while the local markets are in the Coast province.

The farmers clearly indicated that pigeonpea is planted in October/ early November of any given year and is considered as an annual crop. This is in contrast to observations made by Omanga *et al.* (1991) in Coastal areas where farmers allowed pigeonpea to grow for 2 to 3 years. Drought, lack of good cultivars, lack of seeds, insect pests and diseases were considered as main constraints in pigeonpea production. Insect pests were closely linked the constraints of insecticides unavailability in the nearby market, their high costs, lack of knowledge on their correct use, lack of pumps and water. A few farmers knew of indigenous methods of controlling both field and storage insect insect pests but this needed a follow up to establish the plants and their potential as botanicals. Farmers were not informed on how to cope with *fusarium* wilt.

Wildlife especially elephants were considered as a serious menace in pigeonpea production in Mwachabo as at the time the animals invade the farms usually only the long duration pigeonpea crop is in the farms as other crops have already been harvested. Farmers indicated that elephants seemed to have a special liking for the pigeonpea crop. Lack of seeds supply and early and medium maturing cultivars was tackled through initiation of seed production by six farmer selected farmers in Mwachabo. In Mwachabo sublocation poor infrastructure and lack of transport were noted as being important and also influencing marketing of their farm produce.

On completion of PRA and household interviews, the community action plans were assessed and those concerned with pigeonpea production were implemented. All farmers (about 330 farmers) who participated in the PRA received at least two cultivars of 1kg each. However, only 160 farmers were randomly selected to participate in pre-extension trials and six farmers, who were selected by fellow farmers, became seed producers. The final evaluation conducted in September 1998 clearly indicated that the farmers are willing to start growing pigeonpea in a larger scale. The reasons given by the farmers are diverse but included high yields, palatability of the pigeonpea cultivars introduced and marketability of this crop as for the fast time of their history they said the traders have defied the poor road infrastructure and come to buy pigeonpea in Mwachabo.

By growing and marketing the various cultivars the farmers have been able to come up with correct and accurate assessments of these cultivars. For instance large and bold seeds are important for marketing and cvs ICEAP 00068 and NPP 670 fit in this category. Cv ICPL 87097 was still considered as being important in the food security strategy despite having small seeds. Cv Kat 60/8 has small seeds, not easy to shell, takes longer to cook but had the advantage of being available in green pods for long periods and was considered important as a food crop. Cv ICP 6927 was rated average in the positive qualities. It is important to note that all the five cultivars are susceptible to *fusarium* wilt and the major insect pests namely pod sucking bugs, pod flies, pod borers and bruchids. Thus, as the farmers get into larger scale production of pigeonpea in Mwachabo they have to be trained further in crop protection measures.

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