Policy and Institutional Interventions to Revitalize Kenya's Pyrethrum Industry

John Omiti
Nicholas Waiyaki
David Otieno
Anne Chele

Productive Sector Division
Kenya Institute for Public Policy
Research and Analysis

KIPPRA Discussion Paper No. 68
March 2007

KIPPRA
The KENYA INSTITUTE for PUBLIC
POLICY RESEARCH and ANALYSIS

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Published 2007

Bishops Garden Towers, Bishops Road
PO Box 56445, Nairobi, Kenya
tel: +254 20 2719933/4; fax: +254 20 2719951
email: **admin@kippra.or.ke**
website: http://www.kippra.org
ISBN 9966 777 16 4

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KIPPRA acknowledges generous support from the European Union (EU), the African Capacity Building Foundation (ACBF), the United States Agency for International Development (USAID), the Department for International Development of the United Kingdom (DfID) and the Government of Kenya (GoK).

Abstract

Kenya has been the leading global pyrethrum producer for over four decades. The sub-sector has made significant contribution to economic growth through employment generation, foreign exchange earnings and livelihood improvement over this period. However, domestic production as well as export supply has recently been on a drastic downward trend. International competition, especially from Tasmania, Tanzania and Rwanda has become stiff, thus eroding Kenya's hitherto global market dominance. It is against this background that this study was conducted to explore policy options that would enable stability of domestic production and sustainability of the pyrethrum industry in future. The study was undertaken through farm-level surveys in key pyrethrum growing areas, and interviews with relevant stakeholder institutions in the country. Study findings indicate that despite a high desire by farmers to continue pyrethrum production, stability of supply in the future depends greatly on how well farm-level and institutional level constraints are addressed. The key constraints that need to be addressed include delays in payment of farmers, low value addition, poor marketing, lack of stakeholder participation and mismanagement of pyrethrum institutions. Some policy measures are suggested to improve institutional and regulatory framework, enhance competitiveness and promote sustainability of Kenya's pyrethrum industry. Further research is suggested on the potential for up-scaling pyrethrum production; breeding approaches to improve pyrethrin content; alternative value addition strategies; estimation of export potentials in current and emerging markets; and projection of likely drivers of global competition in the medium and long-term.

Abbreviations and Acronyms

ADB	Asian Development Bank
AGOA	African Growth and Opportunity Act
BRA	Botanical Resources Australia
DDT	Dichlorodiphenyltrichloroethane
DPIWE	Department of Economic Development and Industry, Tasmania
EPZ	Export Processing Zone
EU	European Union
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization Statistics
GDP	Gross Domestic Product
GDS	Global Development Solutions
HAL	Horticulture Australia Limited
HIV/AIDS	Human Immuno-Deficiency Virus/Acquired Immune Deficiency Syndrome
IFAD	International Fund for Agricultural Development
IPEP	International Persistent Organic Pollutants Elimination Project
KAPP	Kenya Agricultural Productivity Project
KARI	Kenya Agricultural Research Institute
KPGA	Kenya Pyrethrum Growers Association
LPG	Liquefied Petroleum Gas
MDGs	Millennium Development Goals
NGOs	Non-Governmental Organizations
NIE	New Institutional Economics
NPRS	National Pyrethrum Research Station
PBK	Pyrethrum Board of Kenya
PCK	Pyrethrum Company of Kenya
PRC	Pyrethrum Research Company
SACCOs	Savings and Credit Cooperative Organizations
SSA	Sub-Saharan Africa
TB	Tuberculosis
TIAR	Tasmania Institute of Agricultural Research
VAT	Value Added Tax
WBCSD	World Business Council for Sustainable Development
WHO	World Health Organization

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Acknowledgements

We acknowledge contributions from various individuals and institutions towards successful completion of this study. In particular, we appreciate the cooperation and participation by pyrethrum farmers in the field surveys, stakeholder institutions for their suggestions on potential institutional reforms, and researchers from KIPPRA for their insightful comments on earlier drafts of this paper. Finally, we thank all the research assistants who took part in the study.

1. Introduction

1.1 Global Pyrethrum Supply and Demand

Pyrethrum is the most unique and widely used biopesticide in existence. Its products kill a wide range of insect pests, including those commonly found in and around human dwellings, various insects that infest stored grain and other foodstuffs, in veterinary insect control, as a spray in the food processing industry, and as a pre-harvest spray. The main advantages of pyrethrum include its effectiveness at a low dosage, rapid breakdown in sunlight (unlike synthetics) and non-accumulation in food chains or ground water (Rhoda *et al.*, 2006).

Production of the crop is concentrated in highland zones, usually 2,200m above sea level, where temperatures are cool (around 15^0C) and solar radiation is high. The crop grows well in areas with fairly high rainfall of about 1,000-1,500mm, and with a dry spell during flowering and harvesting. It is a perennial crop that takes 4-6 months to harvest after planting and is replaced after 4-5 years. It flowers continuously for 9-10 months and can provide steady income if regular payments are guaranteed. Yields can be about 4 tonnes of fresh flowers or one tonne of dried flowers per ha (WBCSD, 2004).

The major pyrethrum suppliers in the world have remained the East African countries of Kenya, Tanzania and Rwanda. Between 1961 and 2004, global pyrethrum production was characterized by wide yearly fluctuations, with the highest production occurring in 1983 while the lowest was in 1986 (Figure 1). Over the 44-year period, the three East African countries supplied more than 80 percent of global pyrethrum output. Ecuador, Japan and Papua New Guinea filled the production gap from 1961 to 1979. However, production from the latter three countries dropped considerably thereafter. Since its entry in pyrethrum production around 1980, Tasmania has played a significant role in bridging the production gap between world output and the supply from African countries. Kenya's production trend has been consistent with the world trend, owing to various domestic and global developments. In the immediate post-independence period (1964-1973), the establishment of individual ownership and large land transfer programmes enabled expansion of land under cultivation and a transition from low value to high value agriculture. Generally, agricultural output declined between 1973 and 1975 and recorded mixed trends onwards despite protectionist measures taken by the government in response to economic difficulties—oil crisis, foreign exchange crisis, and fluctuations in international trade (Nyangito and Nzuma, 2005).

Upon the introduction of synthetic insecticides in the world market in 1975, pyrethrum output—both the global as well as that from Kenya—recorded significant declines. In 1977, the great tea boom occasioned a further drop in pyrethrum supply as most tea exporting countries that also produced pyrethrum took advantage of the rising tea enterprise competitiveness by growing more tea and less pyrethrum. This trend was reversed in early 1980s due to the emergence of environmental concerns in key global markets (particularly Europe and USA) on the safety of synthetics. The highest pyrethrum production in Kenya was realized in 1983, but the 1984 drought seriously affected the output in subsequent years. Further to this, from 1985 onwards advanced technology in synthetic product innovation and aggressive promotion of the synthetic insecticides have discouraged increased production of natural pyrethrum not only in Kenya but worldwide (Gerdin, 2002).

World pyrethrum production is about 14,000 tonnes of dried flowers, while demand is estimated at 20,000 tonnes per annum (IFAD, 2004). This gap has encouraged the increased manufacture of chemical substitutes such as organo-phosphates, carbamates and pyrethroids. However, there are growing concerns regarding widespread use of synthetic chemicals and their potentially harmful effects to people and the environment. Kenya has been a major pyrethrum producer, supplying close to 65 percent of world market

share from the year 1960 to 2000. The United States of America (USA) has the largest market for pyrethrum and absorbs about 60 percent of Kenya's exports. Other buyers of Kenya's crude pyrethrin include Europe (Germany, Holland, Spain, Italy) 35 percent; Egypt and South Africa 2 percent each (Rhoda *et al.*, 2006).

1.2 Research Problem

Pyrethrum production in Kenya has dropped significantly from a considerable level of 28,643 tonnes in 1983 to 16,000 tonnes in 1992, a dismal 8,000 tonnes in 2004 and less than 3,000 tonnes in 2005 (FAO, 2006). The pyrethrum export volume and value also declined by 44 percent from 117 tonnes worth Ksh 800 million in 2003, to 66 tonnes valued at Ksh 680 million in 2004 (Republic of Kenya, 2005a). The relative importance of the crop in terms of foreign exchange earnings has dropped drastically from fifth among key sub-sectors in 2002 to beyond ten in 2005. It has been overtaken by high value commodities such as horticulture, tea, tourism, coffee, tobacco, scrap iron and steel products (Republic of Kenya, 2006a).

The country's position as a world leader in the production of pyrethrum, is threatened by erratic and unreliable supply mainly due to institutional challenges such as non-payment/delayed payments to farmers by the Pyrethrum Board of Kenya, which have resulted in massive uprooting of the crop in favour of stable horticultural enterprises. In addition, 99 percent of Kenya's exports are in crude pyrethrin form. The country then spends its scarce foreign exchange to import manufactured insecticides, most of which may not contain pyrethrum (IFAD, 2004).

Most of the local pyrethrum-based industries in Kenya have closed down due to unavailability and irregularity of supplies of pyrethrum, and also partly due to a duty regime that favours importation of finished insecticide aerosols at the expense of locally manufactured ones. Subsequently, all the leading aerosol insecticide brands such as Doom, Raid and Johnson IT that some years ago were locally manufactured are now imported from Australia, Belgium, Indonesia, Malaysia and the Netherlands. Some of these imported formulations pose serious environmental challenges as they do not contain pyrethrum as the active ingredient. Local mosquito coil manufacturers also face competition from cheap brands imported from China, India and Indonesia.

The closure of the pyrethrum-based industries has resulted in idle installed machinery, loss of employment and lost opportunities for the expansion of the industry (EPZ, 2005). Majority of poor farm-households whose livelihoods greatly depended on the crop have lost incomes. Consequently,

the benefits from pyrethrum production to the Kenyan economy are greatly reduced.

1.3 Objectives of the Study

The study sought to review the status of Kenya's pyrethrum sub-sector and explore interventions that would promote a globally vibrant and sustainable industry in future. The specific objectives were to:

(i) Analyze the main determinants of future pyrethrum production;

(ii) Highlight emerging threats and opportunities for Kenya's pyrethrum;

(iii) Identify desired interventions by stakeholders; and

(iii) Suggest policy and institutional interventions.

1.4 Rationale for the Study

Pyrethrum production supports the livelihoods of about 200,000 Kenyan households with smallholdings of 1 acre or less (IFAD, 2004). A vibrant pyrethrum industry would contribute towards creation of jobs in the local industries that use pyrethrum extract as raw material, such as those manufacturing aerosol insecticides and mosquito coils, besides the potential for livelihood improvement through forward and backward linkages in the economy. Manufacturers of aerosol sprays would form linkages with other value chain actors such as suppliers of Liquefied Petroleum Gas (LPG), local oil companies supplying industrial solvents, can manufacturers, animal feed and vector control manufacturers. Effective commercial linkages in the value chain for export commodities are crucial for improved foreign exchange earnings and Gross Domestic Product (GDP) that would spur economic growth (Republic of Kenya, 2006b). Global concerns over harmful effects of synthetics on natural biodiversity provide unique opportunities to revive the pyrethrum sub-sector in Kenya and to improve the livelihoods of many farmers (Republic of Kenya, 2000).

Current government efforts to facilitate payment of farmers' arrears through the Pyrethrum Board of Kenya are essential. In order to boost such initiatives, there is need for stakeholder participation in decision-making and implementation on all aspects necessary for the revival of the pyrethrum industry. The findings of this study will be useful in informing the sectoral policy reforms on growth and development of a stable and profitable pyrethrum industry (Republic of Kenya, 2004a). It will also enhance efforts towards realizing targets of the Millennium Development Goals (MDGs) especially for health, environmental management (global malaria control by

use of pyrethrum-based products) and poverty reduction as envisioned in key national policy documents (Republic of Kenya, 2006c; 2005b). Furthermore, improved performance of pyrethrum institutions is key to orientation of agricultural organizations towards customer needs for enhanced national development (Republic of Kenya, 2006d).

2. Overview of the Pyrethrum Industry

2.1 Pyrethrum Industry in Kenya

Prior to independence in 1963, pyrethrum was mainly cultivated by large-scale farmers in the former White highlands. This has progressively changed and today, more than 95% of the crop is grown by about 200,000 small-scale farmers. Favourable areas for pyrethrum production in Kenya include Nakuru, Nyandarua, West Pokot, Laikipia, Kisii, Kiambu and Bomet. Nakuru district accounts for more than one-third of national output, with an estimated 37,000 farmers cultivating about 10,000 hectares of pyrethrum flowers and producing 5,700 tonnes. Nyandarua and West Pokot districts are second and third, producing about 800 tonnes and 600 tonnes, respectively (IFAD, 2004).

Kenya's pyrethrum industry largely exports crude pyrethrin (99%), while the domestic insecticide/pesticide manufacturing takes only 1 percent of the total production. The domestic market is traditionally controlled by a small number of multinational pesticide manufacturers and traders such as Johnson & Johnson, Roussel, Bayer, Sara Lee, Reckit & Colman, Aventis, Coil Products (K) Ltd and KAPI Ltd. The later two specialize in the manufacture of mosquito coils, mosquito chips and sticks.

Some of the main institutions that deal with pyrethrum in Kenya include: (i) Pyrethrum Board of Kenya (PBK), (ii) National Pyrethrum Research Station (NPRS), (iii) Kenya Agricultural Research Institute (KARI), (iv) Kenya Pyrethrum Growers Association (KPGA), (v) Cooperatives, (vi) Manufacturers, and (vii) Traders (middlemen).

The Pyrethrum Board of Kenya directs and controls the industry, registers and licenses growers, buys dry flowers from growers, and sells extracts mainly to overseas buyers. The National Pyrethrum Research Station collaborates with the Kenya Agricultural Research Institute to produce seed and to breed suitable clones and varieties for different agro-ecological zones based on adaptive research. Beginning mid 1990s, the Pyrethrum Board's financial health has suffered due to fluctuating market conditions, operational inefficiencies and government legislation that limits the Board in its abilities to source for competitive development funds.

Consequently, pyrethrum farmers in the country have been lobbying, through the Kenya Pyrethrum Growers Association, for liberalization of the pyrethrum sub-sector in order to allow them to sell directly to local manufacturers, besides enhancing efficiency and competition. They have also urged the government to come up with policies that encourage local manufacturing of pyrethrum products and value-addition to the exported product. The current Pyrethrum Act (CAP 340, Laws of Kenya) restricts

processing, regulation and marketing of the cash crop to the state-owned PBK. The government, in collaboration with various stakeholders in the industry, has started discussions to review laws and statutes affecting the pyrethrum industry in order to allow for a more participatory and efficient environment (Republic of Kenya, 2004a).

2.2 International Competitors

Tasmania, Tanzania and Rwanda are the main competitors to Kenya in terms of their contribution to global pyrethrum supply. In Tasmania, pyrethrum is a rapidly expanding crop especially on large-scale farms. With a rapid growth in its share of the world pyrethrum market from 10 percent in 2003 to 30 percent in 2005, Tasmania is now the second largest producer (DPIWE, 2006). Tasmania is a technologically advanced competitor, with an emphasis on research and development. Run by a privately owned company—Botanical Resources Australia (BRA)—the Tasmanian pyrethrum industry is considerably mechanized. Sowing, cutting, harvesting, extraction and refining are all performed by state-of-the-art equipment.

Coordination of pyrethrum research, development and extension is done through continuous liaison with the Department of Economic Development, other government agencies and Tasmania Institute of Agricultural Research (TIAR). The funds for the BRA Pyrethrum Research and Development Committee are provided in part by growers, who contribute a 2.5 percent levy, the BRA and other stakeholders such as chemical companies.

The Commonwealth Government of Tasmania, through Horticulture Australia Limited (HAL), supplements the funding provided by growers for the support of research, development and marketing services. Currently, the Tasmanian pyrethrum industry is mainly focusing on:

(i) Further development of existing product lines to improve cost efficiencies;

(ii) Development of additional pyrethrum products from the current by-products;

(iii) Improving production systems to offset current market demand; and

(iv) Improving utilization of processing capacity by processing of other oil crops, e.g. sunflower.

Pyrethrum production in Tanzania has been improving especially after privatization of the processing industry in 1998 when it was producing 1,300 tonnes a year. Since then, production has increased to 2,500 tonnes (about 18% of average world supply) annually (Financial Times, 2005). Following

farmer sensitization and strategic market opportunities provided by the European Union (EU), Tanzania is in a position to increase its pyrethrum output. The Tanzania Pyrethrum Processing and Marketing Co. Ltd is in the process of building a refinery to improve value addition.

Rwanda's third largest foreign exchange earnings are from pyrethrum, after coffee and tea. The three crops together account for about 81% of Rwanda's $66.2 million in exports. Rwanda produces 5 percent of the world pyrethrum supply. With gloom hanging over its main cash crop—coffee—the country is gradually reviving pyrethrum exports after a near collapse due to prolonged civil war. Good rainfall and rich soils have helped make Rwanda's pyrethrum famous for its high quality and attracted interest from pyrethrum investors in the US, Italy, Japan and Germany.

There are also renewed efforts to improve output by minor suppliers such as Papua New Guinea, which produces 2 percent of global share (FAO, 2006). The recent improvements in pyrethrum sub-sectors of competing countries pose a re-awakening challenge to the Kenyan pyrethrum industry.

2.3 Lessons for Kenya

Changes in the global markets and restructuring of pyrethrum industries of the major competitors offer useful lessons that would improve Kenya's position as the leading supplier. Some of the vital issues include:

(a) Institutional support

Effective management of pyrethrum institutions requires a clear distinction of the role of the government and private sector, and a coordinated framework of operation for each actor. Relevant institutions must also streamline sustainable investments to promote value addition.

(b) Research

Applied market research and innovations in production systems and processing technologies are critical to secure a competitive edge in the world market.

(c) Trade Agenda

High-value export trade has enormous potential for economic reconstruction and poverty reduction. However, policy measures are needed to promote equity in the distribution of export proceeds among all stakeholders. In Kenya's pyrethrum value chain, participants in the commodity export markets should be cognizant of global economic intelligence principles, more so to reduce huge disparities between international prices and farm-level payments.

3. Literature Review and Conceptual Framework

3.1 Literature Review

Sustainable agricultural development requires proper coordination of production, processing, distribution and marketing functions in harmony with natural resource systems. The success of these processes greatly depends on existence of effective institutions that are able to respond to both local and global changes in the commodity markets, as well as in the policy frameworks (ADB, 2005). Livelihood improvement from commercial agriculture also varies considerably with the level of stakeholder participation in decision-making (FAO, 2002). Recent national statistics (Republic of Kenya, 2005a) indicate that pyrethrum would provide more robust income throughout the cropping year unlike seasonal crops.

Distortions in policy environment and markets have been cited in some previous studies as key constraints to the pyrethrum industry in Kenya (IFAD 2004; Republic of Kenya, 2004b). However, no attempts have been made to rank the constraints, and this makes it difficult to prioritize solutions for policy action given scarce resources. These studies also highlighted stiff competition resulting from synthetics and imports of processed pyrethrum products, as well as challenges of tight international trade requirements, but failed to suggest coherent mechanisms for addressing the impediments.

There is wide acceptance of diversified uses of pyrethrum products, such as their application as herbicides and stabilizers (Jovetics, 1994). The environmental-friendly nature of pyrethrum also makes it quite useful as a critical component in most pesticide formulations worldwide. Indeed, pyrethrum products are considerably suitable for addressing some of the health concerns articulated in MDGs in an environmentally sustainable manner. However, pyrethrum research in Kenya has tended to lag behind, particularly by failing to highlight mechanisms through which stakeholders in the country could tap investment opportunities in the Global Fund for Malaria, HIV/AIDS and TB. Strategies of accessing emerging export market opportunities (especially in Asia) have also not featured in previous studies. Value addition provides a good option for diversifying use of pyrethrum products and raising farm incomes. Indeed, aggressive processing of primary commodities for export markets contributes significantly to employment creation, increased raw material production, improved investment in infrastructure development and increased export value, especially in the Newly Industrialized Countries such as Malaysia and Thailand (*Ganewatta et al.*, 2005).

Currently, Kenya exports 99 percent of its pyrethrum products as crude pyrethrin while only 1 percent is processed for use in the domestic market.

There is, therefore, a wide scope for adding value to locally produced pyrethrum. One of the key determinants of the value of pyrethrum is its pyrethrin content, which is affected by the type of seedlings planted, crop husbandry and processing practices (Republic of Kenya, 2006f).

Finally, some studies have noted failures in Kenya's pyrethrum institutions and expressed the need to reform those institutions. However, no clear reform path that fully incorporates all stakeholders' views is suggested by these studies. For instance, the IFAD (2004) study recommended replacement of the current government-run PBK with a private company, the Pyrethrum Company of Kenya (PCK), but failed to indicate the best method of constituting the PCK and the desired stakeholder representation. Another recent study on Kenya's pyrethrum sub-sector (Kariuki, 2006) suggests the need for enhanced value addition and institutional governance, but largely ignores the role of farmers in these essential value chain transformation processes. The foregoing gaps in literature present a daunting task in regaining the competitiveness of Kenya's pyrethrum industry, more so towards sustainable development. This study addresses some of these challenges, with the aim of improveing stakeholder participation in policy formulation, and ensuring a stable future for the country's pyrethrum sub-sector.

3.2 Conceptual Framework

The study is based on production theory and the New Institutional Economics (NIE) framework. The NIE framework incorporates the theory of institutions into neo-classical economics and emphasizes the role of institutional efficiency as an impetus for increased production and productivity improvement (Commons, 1992). It also postulates that institutions, especially property rights, are crucial determinants of the efficiency of markets. Institutions are made up of formal rules, informal norms, and enforcement characteristics of both.

The essence of establishing stable institutions is to create a favourable environment for business growth by reducing transaction costs such as the cost incurred in market search, negotiations, contract enforcement and monitoring of business relationships. In reducing transaction costs, institutions enhance competitive advantages for local enterprises by improving their efficiency and sustainability (Porter, 1985). Institutions also establish governance structures to mitigate conflicts and promote mutual gain by value chain participants (Williamson, 2000). The productivity of agricultural investments (e.g. pyrethrum) depends on policy and institutional arrangements that govern production, processing and marketing (Odhiambo and Nyangito, 2003).

In the pyrethrum industry, there is potential for ensuring sustainable livelihoods through stakeholder involvement in policy formulation in production, value addition and marketing processes (Figure 2). Policies that guarantee access to production resources such as land, labour, credit, extension and planting materials are important. Relevant stakeholders should be actively involved in the design and choice of production inputs and systems (e.g. herbicides) to minimize environmental hazards. At the processing stage, involvement of stakeholders (especially farmers, government and businesses) in formulation of policies that promote investments in low-cost value addition is critical. Pesticide formulations and packaging need to be undertaken in ways that protect the natural biodiversity.

Policies that strengthen property rights and institutional management structures and capacities would provide incentives for beneficial participation by farmers and other stakeholders in the pyrethrum value chain. Effective targeting of pyrethrum products to niche markets, competitive pricing, reduced transportation costs and mitigation of post harvest losses also contribute to improved enterprise performance (WBCSD, 2004). Stakeholder participation in policy-making and implementation would provide desired outcomes for sustainable livelihoods (e.g. better input and output prices, increased production, stable incomes and enhanced quality of environmental resources).

4. Methodology

4.1 Study Sites and Sampling

Pyrethrum production has traditionally been concentrated in the Central highlands (Nyandarua, Kiambu), upper parts of Eastern province (Embu, Meru), Rift Valley area (Nakuru, Bomet) and south western Kenya (Kisii). However, dynamics in enterprise competitiveness has gradually changed land allocation patterns and enterprise choice in those regions, with massive disadoption of pyrethrum. For instance, French beans, coffee and banana are currently the dominant enterprises in Embu and Meru, while in Kisii, tea and dairy have replaced pyrethrum (Wanjala *et al.*, 2007).

The study was conducted in Molo and Keringet areas of Nakuru, which are the main pyrethrum growing areas in Kenya (IFAD, 2004). The study was also carried out in the Kinangop - Naivasha area in order to capture competition from the emerging vegetables sub-sector due to proximity to markets in Nairobi (Omiti et al., 2004). In addition, stakeholder institutions in Nairobi and Nakuru were covered in the study.

Sampling lists of pyrethrum farmers were obtained from the district agricultural offices in three main growing zones: Nakuru, Naivasha and Kinangop. The lists had 1,201 pyrethrum farmers (906 in Nakuru, 208 in Naivasha and 87 in Kinangop). A total sample of 110 farm-households was randomly selected from the sampling lists. The sample was spread in two districts to capture variations in spatial market access. Thirty seven (37) pyrethrum stakeholder institutions were also selected in Nairobi and Nakuru using purposive-random sampling (Reid, 2000). Seven (7) institutions declined to be interviewed due to institutional bureaucracies. Various categories of institutions that responded to the survey questions are indicated in Table 1.

4.2 Data Collection

Both primary and secondary data were collected on various aspects of the pyrethrum industry. Primary data was obtained through structured interviews and discussions using questionnaires in field surveys at both farm and institutional levels. The primary farm-level data comprised of information on farm characteristics, competing enterprises, farm level constraints, marketing problems with cooperatives/unions and pyrethrum cess boards, and reforms desired by the farmers. Ranking of enterprises in terms of their importance for food supply, income generation or for both, and farmers' willingness to continue pyrethrum production was also done. Secondary data comprised of data on domestic and global pyrethrum production trends, main

Table 1: Particpating pyrethrum stakeholder institutions

Category	Number of respondents
Manufacturers (processors)	5
Cooperatives	4
Ministry of Agriculture (district officials)	4
Local traders (e.g., middlemen)	3
Ministry of Trade and Industry	3
Research organizations (e.g., KARI)	3
Exporters	2
Transporters	2
Assemblers	2
Universities (e.g., Egerton)	2
Total	30

export markets and main competitors, international trade issues, and value addition in the pyrethrum industry.

4.3 Data Analysis

Both descriptive and quantitative methods were used to analyze data. Descriptive measures (e.g., bar graphs, line graph, pie charts, and percentages) were used to illustrate production trends, constraints, enterprise competition, institutional framework, stakeholder involvement and desired reforms. A vibrant pyrethrum industry requires continued production of the crop at sustainable levels. It is therefore important to critically examine the factors that might influence stable supply of the crop in future. The main determinants of a household's probability to continue pyrethrum cultivation were analyzed using a binomial probit model. A binomial probit model is used in this study because the dependent variable is binary and the model gives smaller standard errors compared to the logit form in a binary case (Greene, 2002).

In the binomial probit estimation, the dependent variable (y) takes binary values (y = 1 if a household is willing to continue cultivation of pyrethrum, and y = 0 otherwise). The binomial probit model is based on the random utility framework (Amemiya, 1981; McFadden, 1973). The underlying assumption in this model specification is that a household would be willing to continue production of pyrethrum if the expected returns (utility) from

pyrethrum are higher than other alternatives, subject to elimination of various impediments such as production and marketing constraints in the pyrethrum supply chain (Equation 1).

$$\text{Prob}[y_i=j]=\frac{e^{b_j'x_i}}{\sum_{i=1}^{j} e^{b_j'x_i}} \quad \text{.....(1)}$$

The probability of a household continuing pyrethrum production was specified as in equation 2:

$$\text{Prob}[y_i=1]=F(\beta'x_i), \text{ such that } 1 \leq F'(\beta'x_i) \quad 0 \text{.....(2)}$$

Where F is a function of n explanatory variables expressed as in equation 3:

$$F_i=\beta_0+\beta_1X_1+\beta_2X_2+...\beta_nX_n+U_j \text{.....(3)}$$

Where β_0 is the intercept, β_1 are the slope parameters in the estimated model and U_j are the disturbance terms. The parameters of the probity model were estimated using the iterative maximum likelihood estimation criteria because of its unbiased, consistent and asymptotically efficient estimates (Mukras, 1993). The goodness of fit of binomial probit models is measured by the statistical significance of the log likelihood function. The explanatory variables estimated and the expected signs of their parameter estimates are shown in Table 2.

Table 2: Variable specification for empirical analysis

Variable	Expected sign ($ß_{i)}$	Interpretation
Gender (0=female, 1=male)	+	Male farmers are less vulnerable to production constraints
Age (years)	+	Investment decisions are mainly made by adults
Education (0=primary & below, 1=secondary & above)	+	Education improves access to production resources and quality of decision-making
Land scarcity (0=No, 1=Yes)	-	Lack of secure land title reduces incentives for investment in pyrethrum production
Labor scarcity (0=No, 1=Yes)	-	Labour shortage and cost hinder pyrethrum expansion
Credit inaccessibility (0=No, 1=Yes)	-	Credit inaccessibility limit acquisition of production assets such as seeds
Extension inaccessibility (0=No, 1=Yes)	-	Extension service affects the flow of production and marketing skills to farmers
Total farm size (acres)	+	Larger farm sizes allow expansion of enterprises and benefits from economies of scale
Payment of arrears (0=No, 1=Yes)	+	Payment of farmers' arrears enables them to purchase production inputs and continue production
Pyrethrin content determination (0=No, 1=Yes)	+	Participation in determination of output value motivates farmers to improve quality and output
Membership to cooperatives/unions (1=Yes, 0=No)	+	Cooperatives/unions improve farmers' marketing strength and access to inputs. This would increase acreage cultivated and participation in markets
Exploitation by middlemen (1=Yes, 0=No)	-	Exploitation by middlemen discourages further investment
Cess mismanagement (0=No, 1=Yes)	-	Mismanagement of cess and exploitation of farmers by the cess board reduces farm profitability and discourages further production

Source: Adapted from Hazell and Diao (2004); Odhiambo et al (2004)

5. Research Results

5.1 Production Issues

5.1.1 Farm enterprise mix

Farmers in the study sites grow various crops; mainly pyrethrum, maize, potatoes, beans, onion and spinach. The total farm sizes range from 0.25 acres to 16.00 acres, while the average farm size is 4.01 acres. Maize has the highest average acreage, followed by pyrethrum, potatoes, beans and spinach. Enterprise diversification is an important strategy to achieve food security (through own-farm production and/or purchase from the market). Qualitative enterprise rankings based on households' perceptions showed that for food supply, potatoes, maize and beans are the three most important crops in all study sites sampled. In terms of both food supply and income generation, pyrethrum is second to potatoes, while maize is third in importance (Table 3).

Table 3: Farm enterprise acreage and rankings

Enterprise	% of farmers (n=92)	Average acreage (acres)	Rank for food supply	Rank for income generation	Rank for both food supply and income generation
Maize	85	1.091	2	3	3
Pyrethrum	100	1.036	n/a	2	2
Potatoes	73	0.900	1	1	1
Beans	52	0.322	3	7	7
Onions	22	0.192	10	5	4
Spinach	5	0.111	9	4	5
Cabbages	5	0.059	6	6	6
Peas	9	0.043	5	10	8
Kales	8	0.027	4	8	9
Millet	3	0.016	7	12	12
Tomatoes	2	0.011	12	11	11
Carrots	1	0.005	11	9	10
Bananas	1	0.004	8	13	13

n/a = not applicable

Source: Survey data (2005)

The main competing enterprises in terms of land in Molo and Keringet divisions are maize and potatoes. In North Kinangop, spinach and maize are the main competing enterprises. In Naivasha, onions and maize are the major competitors to pyrethrum (Table 4). Spinach and onions are important commercial enterprises in North Kinangop and Naivasha due to their proximity to urban high value fresh produce markets especially in Nairobi, the capital city. It is also important to note that average farm size varies in the different locations.

Table 4: Average acreage of competing enterprises

Enterprise	Molo (n=47)	Keringet (n=15)	North Kinangop (n=10)	Naivasha (n=20)
Distance from Nairobi (Km)	250	270	50	120
Pyrethrum	1.32	0.97	0.61	0.62
Potatoes	0.54	1.62	0.88	0.63
Maize	1.03	1.70	1.78	1.15
Beans	0.49	0.00	1.35	0.58
Onions	0.50	0.00	1.13	0.78
Spinach	0.00	0.00	3.00	0.63

Source: Survey data (2005)

5.1.2 Constraints to input supply

(a) Land

Efficient land allocation is usually driven by enterprise competition. The need for agricultural land must therefore depend on the amount of land available for cultivation and the relative returns from each agricultural enterprise (Ekborm, 1998). Land constraints usually vary spatially over time and include lack of secure title and scarcity of arable land. Despite various efforts to expand arable land in Kenya (e.g. through irrigation), the growth in land-labour ratio has been on a decline (Odhiambo *et al.*, 2004). Considering the increasing scarcity of arable land in Kenya, the ability to increase productivity per unit of land area is crucial for national economic development.

About 57 percent of the farmers had inadequate cash for expansion of their farm sizes, while some 24 percent had been affected by land clashes

(especially in Molo) and had consequently lost their farms or their crops were destroyed during recurrent clashes. Poor land legislation had also led to denial/loss of title deeds. In recognition of the pivotal role of land in Kenya's development process, the Government is currently undertaking a consultative process to review the Lands Act and the Land Titles Act (Cap 280 and Cap 282, Laws of Kenya) to formulate a National Land Policy that would promote sustainable and equitable use of land (Republic of Kenya, 2006e). At the production stage, secure land tenure systems are necessary to facilitate sustainable investments on the available land holdings (Barrows and Roth, 1990).

(b) Labour

The labour input per farm has a positive influence on agricultural productivity to some extent. Poorer households may find it optimal to increase their allocation of labour into shifting cultivation in response to increased population density. However, better-off households may find it optimal to reallocate their on-farm labour supply to the off-farm sector, in some cases generating a positive rebound effect that leads to lower pressure on the natural resource base (Pascual and Barbier, 2006). Labor availability depends on returns from various competing enterprises, incidence of sickness and disease among labourers, besides other factors. The wage rates offered in different sectors determine labor availability and cost in various competing enterprises. The estimated average wage earnings per employee is about Ksh 5,500 per month (US$1 = Ksh 70 in December 2006), while the gazetted monthly basic minimum wage for the agricultural industry is Ksh 2,096 (Republic of Kenya, 2005a). About 64 percent of the farmers experience labour shortages in pyrethrum production and marketing. The three activities most affected by the labour shortage include transplanting, weeding and picking of pyrethrum flowers.

The average daily wage rate in pyrethrum enterprise in the study sites is Ksh 100, while competing enterprises such as potatoes offer about Ksh 150 per day to the farm labourers. Due to such disparities in enterprise wages, hired labour is regarded as costly and unreliable for pyrethrum production in the study sites. Consequently, a greater proportion of the farm activities in pyrethrum production are undertaken using family labour (Table 5).

Due to labour constraints, most farmers experience delays in pyrethrum flower collection and transportation from their farms. Breakage during bulking, perishability in stores and reduced volume during weighing are other main problems faced by the farmers (Table 6). At the grading stage, decreased volume and quality loss reduces payment per kilogram of pyrethrum flowers.

Table 5: Labour usage in pyrethrum industry

Activity	% of farmers using each type of labour (n=92)			
	Family labour	Hired labour	Both family and hired labour	Total
Land preparation	44	17	39	100
Seedbed preparation	40	21	39	100
Transplanting	36	23	41	100
Weeding	36	24	40	100
Picking flowers	25	27	47	100
Marketing	74	5	21	100

Source: Survey data (2005)

Seasonal labour shortages could be offset through credit provision, input price decreases and product price increases (Woelcke, 2006). Less labour-intensive techniques such as use of animal traction (e.g. ploughing and transportation) may be used to reduce high labour opportunity costs (Lee *et al.*, 2006).

Table 6: Effects of labour problems in the pyrethrum value chain

Stage of marketing	Effect of labour shortage	% of farmers affected (n=92)
Flower collection from farms	Delays	54
Bulking	Breakage	31
Transportation from farm to processors	Delays	38
Weighing	Reduced volume	24
Grading	Reduced volume and quality loss	25
Storage	Perishability / potency	40

Source: Survey data (2005)

(c) Credit

Access to credit enables farmers to purchase farm materials such as fertilizers, improved seeds and herbicides that are important for increasing productivity. Only 20 percent of the farmers use credit for pyrethrum production. The main types of credit facilities used are cash and seedlings. Major sources of credit include farmer groups/unions, merry-go-round, friends/relatives, Savings and Credit Cooperative Organizations (SACCOs) and commercial banks. Farmer groups/unions are the most preferred sources of credit because they provide cheaper credit with flexible repayment terms. However, farmers experience problems of smaller amounts of credit and irregular/untimely supply of credit from the groups/unions.

(d) Extension services

Extension services have a discernible impact on adoption of necessary technologies to support commercial production (Hazell and Diao, 2004; Evenson and Mwabu, 1998). Besides diverse problems of cost and low quality of the planting material (e.g. clones), fertilizer and herbicides required in pyrethrum production, farmers also lack skills and incentives to adopt new varieties. Public research and extension personnel are often stationed far away, while private service providers are costly and do not guarantee better quality. Consequently, farmers lack skills and advisory services on soil testing, crop husbandry and post harvest techniques.

(e) Other variables

Education generally determines farmers' ability to understand and manage unfamiliar technology (Doss and Morris, 2001). Some 48 percent of the farm-level respondents had completed primary level of education, 24 percent completed secondary, 15 percent completed tertiary education, and 11 percent had not attended formal schooling while 2 percent had completed university. Gender and age also influence farmers' access to resources such as land and their share of farm income. These, in turn, determine the farmers' level of motivation to invest and participate in agricultural production.

5.2 Marketing Challenges

Market access and orientation are necessary for improved agricultural performance. Notably, farmers who are closer to well-functioning markets tend to produce more commercial output than those situated far away from markets or those without better market facilities (Dercon and Hoddinott, 2005). Market-oriented agricultural production can improve the livelihoods of many smallholder farmers through employment and enhanced incomes. Kenya's pyrethrum industry faces a myriad of marketing bottlenecks including:

(i) Marketing strategy

Business success in a competitive environment requires a focused marketing plan/strategy (either cost leadership strategy or product/market differentiation strategy). The marketing strategy provides a clear framework on the optimal mix of the key marketing elements (product, price, place and promotion) in order to provide long-term profitability and sustainability (Kotler and Keller, 2006). Despite being the dominant producer of pyrethrum in the world for many years, Kenya does not have a clear marketing strategy for the crop (Republic of Kenya, 2004a).

(ii) Cooperatives and middlemen

Efficient cooperatives and producer associations are expected to provide a means of evoking, among stakeholders and especially farmers, a sense of participation and responsibility in marketing and processing of farm products, in supplying requisites of production, in effecting improvements in crop and animal husbandry and in administering credit (Gereffi, 1994). In Kenya, marketing cooperatives are legal entities established to coordinate/facilitate fair economic exchange of inputs and products while maintaining the cooperative principles articulated in the Cooperative Act (Cap 490, Laws of Kenya).

Results from field surveys in major pyrethrum producing areas show that some 53 percent of the farmers are members of pyrethrum cooperatives/unions. The key problems experienced by farmers in the cooperatives/unions are delayed payments, misuse of funds, poor representation and unskilled leadership (Figure 3).

Figure 3: Main problems in pyrethrum cooperatives/unions

Source: Survey data (2005)

The Pyrethrum Act (Cap 340, Laws of Kenya) gives the Pyrethrum Board of Kenya monopoly in pyrethrum marketing. The PBK buys pyrethrum flowers directly from farmers or indirectly through cooperatives and middlemen. Almost half (49%) of the farmers interviewed sell their pyrethrum (individually or through cooperatives) directly to the PBK, 48 percent sell to both PBK and middlemen while the remaining 3 percent sell to middlemen only. Despite providing an alternative market to farmers and addressing some of the challenges experienced by farmers who sell directly to the Pyrethrum Board of Kenya or through cooperatives, middlemen often offer low prices and fail to pay in some instances.

(iii) Taxation

National taxation systems are often justified on the basis of three main considerations (Silberztein, 2004):

- the need for governments to provide social and merit goods;
- the need for governments to support individuals and segments of the society/economy who are marginalized by the free market operations;
- the intentional use of taxation to correct other free market imperfections.

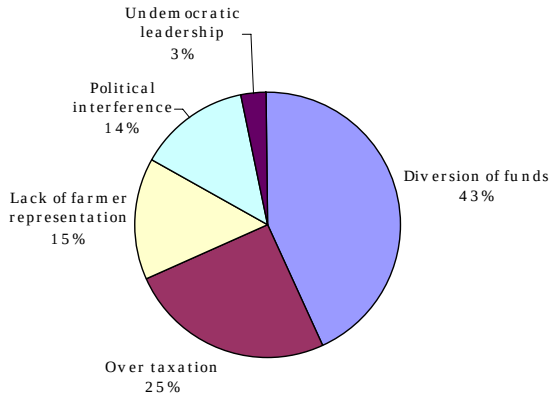
In Kenya, pyrethrum cess is a levy charged by the Pyrethrum Board of Kenya (1% of the total value of flowers sold by each producer) for development of rural roads in the pyrethrum growing zones and 6.6 cents from every kilogram of flowers for capital development. The PBK pays the cess to local authorities on quarterly basis within a pool year (Republic of Kenya, 2004b). As per the local authority Act (Cap 265, Laws of Kenya), 20 percent of the cess is paid by the Pyrethrum Board of Kenya to the respective municipal/ county council's general account and 80 percent to the district roads committees. However, in spite of this levy, most roads in the pyrethrum growing zones are inaccessible and in deplorable state of neglect, especially during the rainy season.

About 65 percent of the farmers indicated that there were various problems in the management boards for pyrethrum cess/road maintenance levies in their respective growing zones. The main cess problems are diversion of funds into non-priority uses, over taxation (the 1% levy is deducted irrespective of quantity of flower delivered and farmer's individual economic circumstances), lack of farmer representation, political interference and undemocratic leadership in the cess boards/committees (Figure 4).

(iv) Pyrethrin content

The profitability of pyrethrum largely depends on the pyrethrin content of the dry flowers upon which the producer price is based; with a higher content

Figure 4: Problems with Pyrethrum Cess Board



Source: Survey data (2005)

fetching a higher price. The Pyrethrum Board of Kenya determines the pyrethrin content and pays Ksh 73.73 for a kilogramme of 1 percent pyrethrin content (Republic of Kenya, 2004b).

Pyrethrin content is affected by the type of seedlings planted, crop husbandry and processing practices. The Pyrethrum Board of Kenya is currently responsible for supplying hybrid seedlings. A good hybrid (P4) seedling or clone material costs as much as Ksh 7,700 per hectare but owing to lack of agricultural credit, farmers have resorted to the use of poor quality planting material. A value chain analysis study by Global Development Solutions (GDS) notes that lack of resources, corruption and bureaucratic inefficiencies have made it virtually impossible for local farmers to access competitively priced, high quality planting material from the Pyrethrum Board of Kenya (GDS, 2004). This scenario has forced many farmers to resort to splitting planting material instead of using fresh seedlings. Consequently, chances of disease occurrence have increased, while the total yields and pyrethrin content have gradually declined. In addition, delays by the Pyrethrum Board of Kenya in inspecting harvested flowers reduce the pyrethrin content due to oxidation. Currently, most farmers produce flowers whose pyrethrin content vary from 1.0 to 1.3 percent; fetching Ksh 73 and Ksh 95 per kg, respectively. It is recognized that pyrethrin content can be raised to over 2 percent through agronomic and technological innovations. This would raise the producer price to Ksh 153 per Kg and increase farmers' incomes by over 60 percent (Republic of Kenya, 2006f).

It is important that farmers be involved in measuring of pyrethrin content. This would assure them of fair pricing and better incomes from their crop. However, in the Kenyan context, there is no farmer involvement in pyrethrin

content determination, consequently leading to blurred measurement systems and manipulation of pricing mechanisms.

5.3 Determinants of Future Pyrethrum Production

Most farmers (85%) were willing to expand their pyrethrum acreage. The dependent variable in the binomial probit model was the probability of farmers to continue pyrethrum production. The model results show that education, land scarcity, labour scarcity, payment of arrears, exploitation by middlemen, mismanagement of cess, total farm size and participation in pyrethrin content determination, were significant in predicting the probability of farmers to continue pyrethrum production (Table 7).

Most of the estimated coefficients were in accordance with the apriori expectations. Education (beyond secondary level) would improve capacity for better investment decision-making. Also, increased farm size, timely payment of arrears and effective participation in pyrethrin content determination would provide the necessary incentive for farmers to continue production of pyrethrum. On the contrary, continued land scarcity, labour scarcity, cess mismanagement and exploitation of farmers by middlemen would discourage stable pyrethrum production in Kenya.

Table 7: Determinants of future pyrethrum production

Variable	Estimate (β)	Standard error	t-ratio	p-value
Constant	-0.106	0.856	-0.124	0.861
Gender	0.369	0.484	0.761	0.446
Age	0.005	0.016	0.290	0.772
Education	0.561	0.228	2.460	0.023*
Land scarcity	-0.855	0.417	-2.050	0.055**
Labour scarcity	-0.452	0.229	-1.974	0.062**
Credit inaccessibility	-0.318	0.213	-1.496	0.174
Extension inaccessibility	-0.643	0.605	-1.063	0.287
Payment of arrears	0.891	0.310	2.874	0.014*
Exploitation by middlemen	-0.730	0.424	-1.723	0.064**
Participation in pyrethrin content determination	0.609	0.221	2.759	0.016*
Cess mismanagement	-0.604	0.389	-1.555	0.065**
Membership to cooperatives	0.299	0.581	0.515	0.606
Total farm size	0.394	0.190	2.074	0.038*

*Significant at 5%, **Significant at 10%. Log likelihood function = -20.997 (p=0.002), N=92.

Source: Survey data (2005)

The insignificance of the constant variable (representing the disturbance term) and the significance of the log likelihood function (at p=0.002) shows that all the independent variables included in the study jointly explain the probability of continued pyrethrum production by the farmers. In all the study sites taken together, most farmers desired prompt payment of their arrears and inclusion in pyrethrum valuation as prerequisites for continued production of the crop. The proportion of farmers who experienced constraints in cooperative membership, credit, cess board, extension, middlemen, labour, and land issues declines in that order. However, the effect of these constraints on future production varies. For instance, although many farmers experience extension inaccessibility compared to cess and credit problems, cess mismanagement would significantly influence farmers' decisions on future production than extension and credit (Table 8).

Table 8: Extent of production constraints in the study sites

Variable	% of farmers affected in Molo (n=47)	% of farmers affected in Keringet (n=15)	% of farmers affected in Naivasha (n=20)	% of farmers affected in Kinangop (n=10)	Total % of farmers affected (n=92)
Willingness to continue pyrethrum production	82.9	100.0	70.0	100.0	84.8
Desire to be paid arrears	80.9	86.7	75.0	100.0	82.6
Land scarcity	80.9	80.0	75.0	90.0	80.4
Labour scarcity	80.9	80.0	80.0	70.0	79.3
Exploitation by middlemen	63.8	93.3	60.0	80.0	69.6
Desire to participate in pyrethrin content determination	55.3	86.7	70.0	90.0	67.4
Extension inaccessibility	61.7	80.0	90.0	20.0	66.3
Cess mismanagement	66.0	80.0	50.0	70.0	65.2
Credit inaccessibility	68.1	33.3	85.0	30.0	62.0
Membership to cooperatives	57.4	26.7	45.0	3 0.0	46.7

Source: Survey data (2005)

5.4 Institutional Performance and Emerging Issues

5.4.1 Institutional reforms

Reforms in the governance structures of key institutions in the pyrethrum industry are critical to modifying the arrangements articulated in the

Pyrethrum Act (Cap 340, Laws of Kenya), which empowers the Pyrethrum Board of Kenya to control all aspects of the pyrethrum industry (IFAD, 2004). These amendments are essential in order to promote competitiveness and sustainability of the pyrethrum industry in a liberalized market. The next section discusses some of the possible approaches that could be used to address various challenges in pyrethrum institutions.

(i) Farmer organizations

The success and survival of groups and organizations depends to a greater extent on the quality of leadership responsible for governance at every stage of the value chain (Mugunieri and Omiti, 2004; Kaplinsky, 2000; Fiedler and Garcia, 1987). Pyrethrum cooperatives and middlemen play a critical role in the marketing chain. Therefore, bottlenecks in these value chain actors require urgent and participatory solutions.

In order to address the challenges experienced by farmers in marketing cooperatives, stakeholder institutions suggested establishment of enforceable contract farming, legislation to check fraud, training and democratic elections. Indeed, in order to streamline managerial efficiency, Parnell (2001) notes that every cooperative or self-help enterprise needs skilled and dedicated leaders primarily drawn from its 'cardinal stakeholder group'.

Some 88 percent of farmers proposed that the middlemen should be eliminated from the supply chain, while the rest suggested that the middlemen should continue providing an alternative but competitive market as well as providing market information to the farmers. Reforms in the way cooperatives and middlemen operate will require a balanced strategy that ensures equitable distribution of the gains from pyrethrum production and trade to all participants along the value chain.

(ii) Management of pyrethrum cess boards

The management system and utilization of tax proceeds from pyrethrum have a bearing on farmers' production decisions. Various mechanisms were suggested for restructuring the management of pyrethrum cess in order to improve farmer participation, governance and welfare. The most desired interventions by stakeholder institutions include joint measures comprising cess tax reduction, democratic elections and legislation to check fraud in the cess boards (Figure 5).

The choice of the best strategy would require consideration of other issues such as utilization of other devolved funds in the pyrethrum zones, dynamics in the democratic processes and the capacity of local stakeholders to manage

pyrethrum cess. Appropriate auditing measures that would promote transparency in the management of the levies also need to be considered.

(iii) Determination of pyrethrin levels

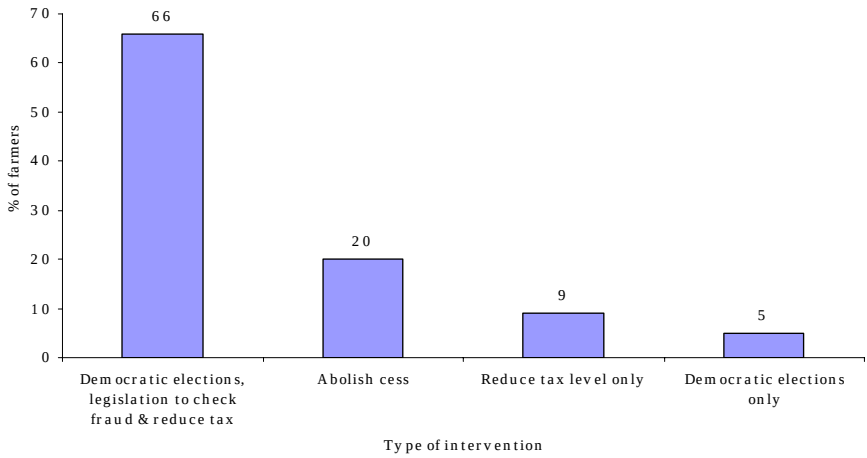
Majority (84%) of the farmers suggested that they should be allowed to participate in determination of pyrethrin content. Most of these farmers (74%) would like individual participation, while the rest preferred group representation during determination of pyrethrin content. These findings demonstrate the need to streamline farm-level involvement in measurement of pyrethrin content and pricing of their pyrethrum flowers. However, the choice of the most appropriate mode of participation should consider the capacity of farmers to understand the process. Farmers' interests may be best served through elected representatives.

(iv) Pyrethrum research institutions

Under the Pyrethrum Act (Cap 340, Laws of Kenya) section 6 (c) and (j), the power of research and development in seed, processing and marketing is vested in the PBK. However, pyrethrum research is poorly coordinated, often occasioned by overlapping activities between PBK and KARI at the National Pyrethrum Research Station (Molo) and various experimental sites. The sites are at Kakamega, Kiambu, Kisii, Mt. Elgon, Nakuru, Nyamira and Nyandarua districts.

Research activities in pyrethrum sector are geared towards development of superior varieties/clones, crop management packages, post-harvest

Figure 5: Mechanisms to restructure cess management



Source: Survey Data (2005)

handling of pyrethrum flowers, seed production, product development and market research. A team of about 50 staff scattered between KARI and PBK carries out these activities. At the moment, research activities are poorly coordinated. Other constraints faced by pyrethrum research include:

(a) High staff costs and inadequate funding for actual research activities;

(b) Lack of prioritization of research activities based on farmer needs;

(c) Weak linkage between research, extension and farmers resulting in low adoption of new varieties and crop management technologies; and

(d) Poor incentives for PBK scientists. Pyrethrum scientists have been working without a well-structured scheme of service for a long time (Republic of Kenya, 2004b).

These scenarios certainly call for the amendment of the Pyrethrum Act (Cap 340, Laws of Kenya) to facilitate increased participation of stakeholders in running the industry. It is desirable that pyrethrum research activities are rationalized under one research institution and experimental sites be designed in line with changing enterprise competitiveness across the country. Indeed, about 60 percent of the survey respondents suggested rationalization of staff at KARI and PBK to ensure more funds for actual research activities.

Perhaps, the interest of pyrethrum stakeholders would be best served by an own-industry research center, as is the case with coffee, tea and sugar sub-sectors. However, the pyrethrum industry is currently relatively small and farmers and other stakeholders may therefore not be able to finance the operations of such a center. Kenya Agricultural Research Institute (KARI) would therefore seem to be currently best placed to undertake pyrethrum research in the country in collaboration with the Pyrethrum Board of Kenya.

(v) Pyrethrum Board of Kenya

Various failures at the Pyrethrum Board have contributed to a decline in Kenya's pyrethrum industry. Some of the major failures that may be attributed to Pyrethrum Board of Kenya and current institutional set-up are:

(a) Low adoption of high quality pyrethrum varieties/clones and hence low productivity of pyrethrum both at the farm and processing levels;

(b) Poor marketing strategies, which result in delayed payment to farmers;

(c) Loss of pyrethrin content due to poor post-harvest handling, delayed inspection of deliveries; and

(d) High cost of pyrethrum products (Republic of Kenya, 2004b; GDS, 2004).

As a result, many stakeholders including farmers and donor organizations have persistently voiced their concerns over the current status of the pyrethrum industry and the need for urgent reforms. Of major concern is that the Pyrethrum Act (Cap 340) of 1964 does not conform to the current liberalized economic environment. The Act places both regulatory and commercial functions under the Pyrethrum Board, thus conferring monopolistic powers on PBK to purchase dry pyrethrum flowers from farmers, process and market resultant pyrethrum products. This has almost led to collapse of the pyrethrum industry. There have been attempts by the Government to develop a policy draft towards liberalization of the sub-sector. However, implementation has not been undertaken (Box 1).

Although the government in 2007 appointed new members to the Pyrethrum Board of Kenya and earmarked some funds for clearing farmers' arrears, the long-term success of the pyrethrum industry requires a complete restructuring of the institutional framework to enhance competitiveness. From the field surveys, it was observed that farmers and other stakeholders had a great desire for changes in the membership and method of appointing representatives to institutions governing the industry. As opposed to the current system of appointment and selection, most respondents suggested that the new national pyrethrum management body (whether PBK or PCK) must be constituted through democratic elections by stakeholders only. It was further proposed by the respondents that the new management board

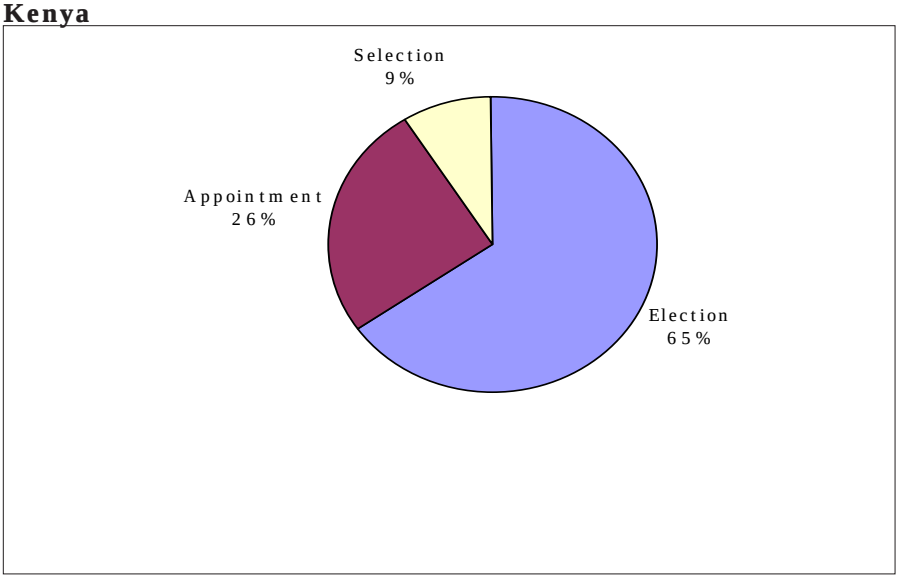
Box 1: Pyrethrum Policy Draft

The Government through the Ministry of Agriculture has proposed a policy blueprint to revive the troubled pyrethrum sub-sector. The policy document developed after consultations with some stakeholders, recommends some changes to the management of the multi-billion shilling industry. During the consultations the Pyrethrum Board of Kenya was accused of running down the industry. Under the proposed policy, the Board will remain a regulator, with farmers forming a company to take over the marketing role from the inept state corporation. "The sub-sector will also be opened to other market players..." The farmers ...are also demanding to own all assets currently in the hands of the Board, including the Nakuru-based pyrethrum processing factory. The World Bank, which promised to fund the revitalization efforts, argued that the multi-billion shilling industry had almost collapsed due to state interference. The donors argued that though Kenya was the world-leading producer of pyrethrum, farmers lived in abject poverty due to poor payments.

Source: The Standard Newspaper Kenya, 4 February 2005, Page 16.

must incorporate a broad range of stakeholders, with majority representation to be held by pyrethrum producers. Ninety-one (91) percent of the respondents stressed that all board members must be demonstrated stakeholders in the pyrethrum industry. Other stakeholders suggested for inclusion in the new PBK board are processors, government, researchers, traders, transporters, bulkers, formulators, financial institutions and local political leaders. The desired method of constituting the new board is shown in Figures 6.

Figure 6: Desired method of constituting the Pyrethrum Board of Kenya

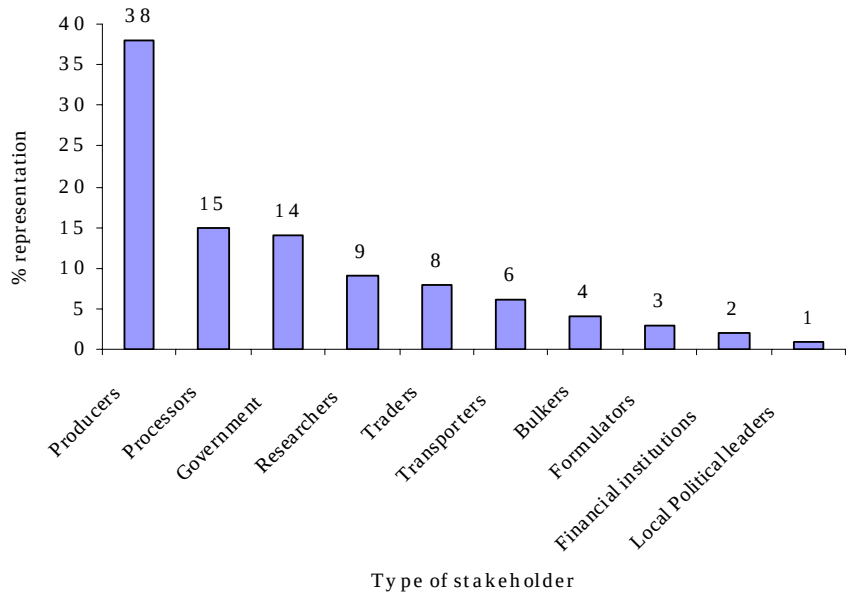


Source: Survey Data (2005)

Proposals were made to broaden stakeholder representation so as to incorporate producers (majority), processors and government, among others (Figure 7).

While it is debatable whether producers should be allowed to have a majority representation in a regulatory body, in a liberalized environment there is need to increase producers' representation through simple majority shareholding in the proposed marketing company. In order to address the challenges facing the pyrethrum industry, it is important that the regulatory functions of the PBK be urgently separated from marketing functions. The pyrethrum draft policy should be widely discussed with stakeholders and urgently finalized to allow for:

Figure 7: Desired representation in the Pyrethrum Board of Kenya



Source: Survey Data (2005).

(a) Restructuring of Pyrethrum Board of Kenya to focus only on regulatory functions such as enforcing regulations, which enhance development of the pyrethrum industry, licensing processors and marketing agents, regulating imports and exports of pyrethrum and products, and arbitrating on disputes within the industry. A comparative regulatory framework akin to the Horticultural Crops Development Authority (HCDA) model may suffice as a starting point for the restructured PBK;

(b) Establishment of a company to carry out the marketing functions currently carried out by the PBK. While the company may initially have a slight government majority shareholding (due to ownership of assets currently held by PBK), arrangements should be made for farmers and other interested investors to purchase at least 70 percent of the shareholding within a short time (e.g., five years) after establishment of the proposed PCK; and

(c) Liberalizing the industry for entry of other interested parties in all fields, including ownership and research into new germplasm, establishment of seed nurseries and propagation centers, growing of pyrethrum, purchase of flowers grown locally, processing and sale of pyrethrum products in the world market.

(vi) Marketing strategy

In order to improve the marketing of Kenya's pyrethrum, most respondents (66%) suggested the need to design a marketing plan and facilitate its implementation through training of PBK/PCK staff and relevant stakeholders on international marketing strategies. Other measures suggested for improved implementation of the marketing plan include setting a definite timeframe, monitoring and evaluation, and increased budgetary allocation for implementation.

(vii) International trade negotiations and compliance

Like other major export commodities, the performance of pyrethrum industry greatly depends on international market regulations. These include:

(i) Regulations on quality requirements;

(ii) Compliance to international contractual obligations; and

(iii) International trade agreements.

Some measures suggested for improving Kenya's compliance with quality requirements include provision of market information on quality requirements to domestic producers and processors (45% of respondents), loans and market information (39%) and quality standardization and technology transfer (12%).

Efforts should also be made to strengthen Kenya's capacity in international trade negotiations. In order to achieve this, most respondents (52%) suggested the pursuance of combined interventions, including training of representatives on key aspects of trade negotiations, increased political commitment at both local and regional levels, and periodic review of international requirements. The rest of the respondents suggested the need for active lobbying by both local and international civil society organizations for fair global trade. There is great need for urgent implementation of these interventions in order to revitalize the pyrethrum industry.

Another important issue in the international market arena is compliance with contractual obligations to promote or enhance stability in export markets. In order to improve compliance with international pyrethrum contracts between Kenya and its main buyers, most respondents (74%) suggested joint measures that include supportive legislation for enforcement of contracts, timely payment of farmers to ensure stable domestic production, and budgetary allocation for purchase of reserve stocks.

5.4.2 Emerging threats and opportunities

(i) Competition from imported products

Due to low value addition on local pyrethrum, imported finished pyrethrum products (mainly aerosols) pose a major threat to the locally processed pyrethrum products, partly due to the relatively low price of imports. Also, synthetic pyrethroids are imported to offset high local pesticide demand. Most of the respondents (86%) emphasized the need to maintain a stable domestic supply of natural pyrethrum, as well as to diversify the use of pyrethrum products in order to check the stiff competition from synthetic pyrethroids.

In order to reduce competition from imported aerosols, many respondents (65%) suggested implementation of joint interventions including strict monitoring of the quality of imported aerosols, removal of Value-Added Tax (VAT) on imported inputs for pyrethrum production and processing, raising of the import duty on aerosols and improvement of the domestic factory efficiency levels, including improving utilization.

(ii) Increased value addition of pyrethrum products

Presently, the average pyrethrin content is 1.3% at the national level. This should be increased to optimal levels through improvement of specific agronomic practices and value addition technologies. This calls for research on mechanisms to improve the pyrethrin content. Kenya also needs to improve its competitiveness in processing of pyrethrum products. Currently, grist (pyrethrum powder) sold by the Pyrethrum Board of Kenya costs about Ksh 208 per kg, while grist of the same pyrethrin content cost about Ksh 105 per kg in Tanzania—nearly half the Kenyan price. For instance, a report by Global Development Solutions (GDS, 2004) notes that for mosquito coil production (one of the most popular products manufactured from pyrethrum powder) in Kenya, mixing (about 80% of which is pyrethrum powder) accounts for the highest value addition cost (57.5%) followed by packaging at 31%. Conversely, in Tanzania, packaging accounts for the highest value addition cost (44.2%) followed by mixing (40.7%). In both countries, other activities such as kneading, extrusion, stamping and drying account for less than 15 percent of the total value addition cost. To increase competitiveness of Kenya's pyrethrum products, the sub-sector needs to carry out its operations more efficiently to lower the cost of pyrethrum powder. Of necessity, this may require liberalization of the sub-sector to allow entry of other companies, which could competitively produce pyrethrum powder and other products.

Increasing competitiveness of Kenya's pyrethrum products would also require lowering of packaging costs. Although Kenya may appear to be more competitive than Tanzania in terms of packaging costs, the country is highly uncompetitive for aerosol manufactures when compared to South Africa and European countries. The cost of packaging materials constitutes 75 percent of the total cost of domestic aerosol insecticide (Kariuki, 2006). Imported packaging materials for fabrication of aerosol cans are taxed at between 10 percent and 25 percent import duty and a Value Added Tax (VAT) of 16 percent. On the contrary, imported finished aerosol products attract a duty of 5 percent and no VAT. The current discrepancy in tax structure clearly discourages local value addition and local formulation of products by Kenyan manufacturers.

It is also important for the government to provide incentives that would promote value addition on exports. This may entail adoption of similar strategies in high value export sectors of the Newly Industrialized Countries. For instance, exemption of domestic manufacturers from manufacturing tax over some period, as in Sri Lanka's tea industry, would stimulate investments in local value addition (Ganewatta et al., 2005).

(iii) New niche markets

The traditional buyers of most of Kenya's pyrethrum have been the US and most of Western Europe. With the growth in world population and changes in market preferences, Asia is now emerging as a major consumer of pyrethrum products. Demand for pyrethrum extracts in the emerging key Asian markets is relatively higher than in the traditional European and American markets. For instance, the average annual imports of pyrethrum extracts in the Republic of Korea, Malaysia and Israel ranges between 35MT and 60MT compared to the 15MT imported by Italy and France (FAO, 2006). Unlike the US and EU, Asian countries have varied pyrethrum-product preferences and less stringent trade restrictions. In order to attract and sustain the emerging pyrethrum markets in Asia, 67 percent of the respondents suggested the implementation of joint measures including strengthening of market information systems, establishment of trade promotion offices in the emerging markets, and budgetary allocation for promotion and production of new pyrethrum products based on the emerging demand patterns and preferences.

Another target market for Kenyan pyrethrum should be the organic farming sector, which accepts only insecticides of natural origin that are without danger for users, consumers and the environment (Copperfield Mosquito Systems, 2005). Organic farming is flourishing on over 3 million

hectares in Europe. Pyrethrum is one of a few natural insecticides admitted without restrictions for organic crops. Kenya stands a good chance of increasing pyrethrum production given the stringent conditions imposed by European consumers on pesticide residue in soil and fresh produce. Also, while continuing to produce pyrethrum products for existing uses such as control of mosquitoes and other pests, efforts to produce pyrethrum products for other uses are needed in order to expand the market share of natural pyrethrum. The main activities for which there exists emerging local demand for pyrethrum products include grain storage, livestock feed, control of maize stem borer, horticulture and soil fumigation.

Recent developments have opened new options for use of pyrethrum products in pest management on smallholdings. A combination of pyrethrum and non-toxic piperonyl butoxide results in a powder that is highly effective in preventing insect damage in stored grain, particularly wheat, maize, barley and oats (Zhongzhi, 2005). Other potential applications include the use of pyrethrum waste materials (marc) to feed livestock. This reduces the load of intestinal parasites, ticks and improves the groom of livestock and other domestic animals.

(iv) Opportunities in the global Fund for Malaria, HIV/AIDS and TB

With increased global awareness of the need to protect and conserve the environment, pyrethrum is an ideal pesticide. The trend away from synthetic ingredients in pesticide formulations in favour of natural plant-derived products has increased world-wide interest in production of pyrethrum. The excess demand over supply together with the world-wide trend away from synthetics provides an opportunity for expansion of pyrethrum production. As the world's potentially largest pyrethrum producer, Kenya is in an excellent position to take advantage of the current global interest in pyrethrum. The Global Fund for Malaria, HIV/AIDS and TB is a major initiative to reduce the devastating impacts of these diseases. Malaria affects 40 percent of the global population and it kills numerous children under the age of five. It is a preventable disease that can be managed by a combination of bed nets, insecticide spraying, and mosquito control strategies. Malaria strikes hardest in the poorest countries of the world; 90 percent of all cases occur in sub-Saharan Africa . In Kenya, Malaria is estimated to kill about 700 people per day (IPEP, 2006).

Although Dichlorodiphenyltrichloroethane (DDT) reduces malaria drastically, Kenya has prohibited its use due to the country's commitment to the Stockholm Convention on Persistent Organic Pollutants as from 23 May 2001. Despite the recent lifting of the ban on DDT (WHO, 2006), there is

need to improve malaria control efforts especially through the use of natural pyrethrin-treated nets instead of synthetics, ostensibly to save the country's over US$300 million worth horticulture industry from contamination and potential import bans in EU that would result from reintroduction of the DDT.

The major opportunity for pyrethrum industry in the Global Fund for Malaria, HIV/AIDS and TB is high demand for malaria drugs. So far, the Global Fund has provided Ksh 250 million to support the fight against malaria using natural pyrethrum insecticides. The challenge, however, is to develop strategies of accessing the various opportunities in the Fund for the improvement of the Kenyan pyrethrum industry as well as the economy. The responses from stakeholder institutions show that the most desired strategy for accessing opportunities in the Fund would be to pursue aggressive campaign on the environmental-friendly nature of Kenya's pyrethrum products (Table 9). Implementation of this option, jointly with production of more pyrethrum-based Malaria drugs, would also enhance Kenya's access to the Global Fund.

Also, trade in malaria-based control technologies such as drugs and nets to all affected countries would provide the much needed capital for domestic pyrethrum production and value-addition, with overall potential positive multiplier effects in the entire Kenyan economy.

Table 9: Accessing opportunities in the Global Fund for Malaria

Desired strategy	% of respondents
Aggressive campaign on environmental-friendly nature of Kenya's pyrethrum products	48
Aggressive campaign and production of pyrethrum-based malaria drugs	39
Increased production of pyrethrum-based malaria drugs	13
Total	100

Source: Survey Data (2005)

6. Conclusions and Recommendations

6.1 Conclusions

The pyrethrum sub-sector is crucial for employment creation, income generation and livelihood sustenance for most rural households in Kenya. Growing enterprise competitiveness, especially from crops that directly generate food and income (e.g. maize and potato) puts much pressure on pyrethrum expansion in terms of land and labour allocation. Poor land legislation and inadequate cash also hinder farm expansion. There is great desire by farmers to stabilize pyrethrum production. However, this will require urgent efforts to address the main constraints, which include non-payment and /or delayed payment of farmers' dues, lack of farmer involvement in pyrethrin content determination, mismanagement of pyrethrum cess and poor stakeholder representation in the Pyrethrum Board of Kenya. Revival of the pyrethrum sector also requires reforms in key pyrethrum institutions, improved value addition and effective strategies to tap local and global market opportunities. Various policy and institutional measures are necessary to enhance pyrethrum enterprise competitiveness, improve institutional and regulatory framework, harness global opportunities and ensure sustainability of the sub-sector in Kenya.

6.2 Recommendations

6.2.1 Improving institutional and regulatory framework

There is need to review the current legal framework (Pyrethrum Act, Cap 340) that places both regulatory and commercial functions under Pyrethrum Board of Kenya. The legal framework should be reviewed to inculcate democratic ideals and participatory stakeholder representation in the governance structures of all pyrethrum institutions. The government should therefore hasten finalization of the current draft policy on liberalization of the pyrethrum industry and review of regulatory framework to provide for:

(a) Restructuring of the Pyrethrum Board of Kenya to focus only on regulatory functions (more so borrowing from the Horticultural Crops Development Authority structure), which can contribute to sustainable development of the pyrethrum industry;

(b) Establishment of a company to carry out the marketing functions currently carried out by the Pyrethrum Board of Kenya. Initially, the government may have a slight shareholding majority since currently all the processing machinery and equipment belongs to the Pyrethrum Board of Kenya. Arrangements should, however, be made to transfer, possibly within five years, majority of the company ownership to

farmers, and other interested investors, preferably through the stock market;

(c) Liberalization of the industry for entry of other interested parties in research, production, processing and marketing;

(d) Kenya Agricultural Research Institute to spearhead research in pyrethrum crop in collaboration with a reformed Pyrethrum Board of Kenya. The proposed marketing company should, however, be mandated to carry out research on processing technologies and product development;

(e) Establishment of enforceable contracts (with punitive anti-violation tax) at all levels of the pyrethrum value chain;

(f) Government to provide a tax-free incentive (e.g. exempt manufacturing tax) to domestic processors in the initial investment period;

(g) Penalization for non-payment/delayed payment of farmers;

(h) Establishment of permanent settlement and land redistribution systems (for instance issuance of genuine long term title deeds and avoid frequent evictions) to promote stable investments;

(i) Government to set up a value-based compensatory fund for internally displaced commercial farmers in clash-prone areas;

(j) Strengthening monitoring systems on the quality of both local and imported aerosols; and

(k) Streamlining and regularizing both internal and external auditing of financial resource utilization in all pyrethrum institutions.

6.2.2 Enhancing enterprise competitiveness

In order to increase productivity and enhance competitiveness of locally produced pyrethrum products, it is recommended that:

(a) Pyrethrum farmers be encouraged, through aggressive extension services, to plant varieties with high pyrethrin content. The government could adopt a cooperative extension provision system to strengthen stakeholder responsibility in skill provision and acquisition (e.g. a joint scheme funded by farmers, traders, processors, government and NGOs);

(b) Farmers be trained and involved in pyrethrin content determination;

(c) Farmers s be provided with credit for purchase of inputs either through Agricultural Finance Corporation, proposed pyrethrum marketing company, cooperative societies or other financial institutions;

(d) The government promotes local processing and packaging of diversified pyrethrum products by lowering import duty and removing Value Added Tax on imported raw materials. The import duty on imported aerosols and other pyrethrum-based finished products should be increased from the current 5%; and

(e) The government and the proposed marketing company establishes a dynamic pyrethrum marketing strategy that involves continuous training of local players in pyrethrum market on emerging market challenges and provision of an up-to-date market information system, among other critical trade facilitation functions. The proposed marketing company should aggressively promote Kenyan pyrethrum (as an environmentally friendly product) in emerging markets, especially in Asia, besides the US and EU. The company should also aggressively market more and diversified natural pyrethrum-based Malaria drugs.

6.3 Suggestions for Further Research

Compared to other high-value export crops such as tea, coffee and horticulture, pyrethrum research in Kenya is still limited. There is need for public and private research institutes and agribusiness firms to venture into pyrethrum research in the following areas:

(i) Potential for scaling up production in various parts of the country;

(ii) Breeding approaches to improve pyrethrin content;

(iii) Alternative value addition strategies;

(iv) Estimation of export potentials in current and emerging markets; and

(v) Forecasting of the likely drivers of global competition in the pyrethrum supply and demand, both in the medium and long-term periods.

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