INTELLECTUAL PROPERTY RIGHTS REGIMES (ACQUISITION AND OWNERSHIP) IN PUBLIC RESEARCH INSTITUTIONS IN KENYA: A CASE STUDY OF KARI, KEMRI AND KIRDI

BY

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THIS DISSERTATION IS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF ARTS IN INTERNATIONAL STUDIES, AT THE INSTITUTE OF DIPLOMACY AND INTERNATIONAL STUDIES, UNIVERSITY OF NAIROBI.

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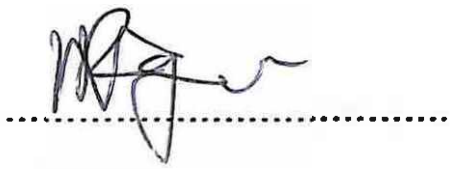
DECLARATION

This dissertation is my original work and has not been submitted for a Masters degree in any other University.



20/11/2009

SIGNED DATE

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This dissertation has been submitted for examination with my approval as a University supervisor.

20/11/09

SIGNED DATE

MR. GERRISHON K. IKIARA

DEDICATION

I dedicate this study to my dearest and beloved daughter, Antoinette (little Angel), you give me reason and purpose to work hard, excel and seek the best in life.

To my parents; Zakayo and Esther in recognition of what they have done to shape my life, without their patience, understanding, support, guidance, sacrifice and most of all love, the completion of this work would not have been possible.

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ABBREVIATIONS

AGOA	-	African Growth & Opportunity Act
ATIRI	-	Agricultural Technology and Information Response Institute
BIRBI	-	United International Bureau for the Protection of Intellectual Property
CBD	-	Convention on Biological Diversity
CBRD	-	Centre for Biotechnology Research and Development
CCR	-	Centre for Clinical Research
CDC	-	Diseases Centers for Disease Control and Prevention- Atlanta, Georgia, USA
CGMRC	-	Centre for Geographic Medicine Research
CIMMYT	-	Centre for Research on Wheat and Maize
CIPR	-	Commission on Intellectual Property Rights
CLSDR	-	Centre for Leprosy and other Skin Diseases
CMR	-	Centre for Microbiology Research
COMESA	-	Common Market for Eastern and Southern Africa
CPHR	-	Centre for Public Health Research
CRCHS	-	Commonwealth Regional Health Community Secretariat
CRDR	-	Centre for Respiratory Diseases Research
CTMDR	-	Centre for Traditional Medicine and Drug Research
CVBCR	-	Centre for Vector Biology and Control Research
CVR	-	Centre for Virus Research
EAC	-	East African Community
EPO	-	European Patent Organization
EU-ACP	-	European Union - African Caribbean & Pacific Countries
FDI	-	Foreign Direct Investment
G7	-	Group of 7
GATS	-	General Agreement on Trade in Services
GATT	-	General Agreement on Tariff and Trade
GDP	-	Gross Domestic Product
GoK	-	Government of Kenya
ICIPE	-	International Centre for Insect Physiology and Ecology
ICRISAT	-	International Crops Research Institute for the Semi-Arid Tropics
IDLO	-	International Development Law Organization
IDRC	-	International Development Research Centre
ILRI	-	International Livestock Research Institute
IMF	-	International Monetary Fund
IP	-	Intellectual Property
IPR	-	Intellectual Property Rights
ISAAC	-	International Study of Asthma and Allergies in Childhood
ITC	-	International Trade Centre
ITROMID	-	Institute of Tropical Medicine and Infectious Diseases

JICA	-	Japan International Cooperation Agency
KIRDI	-	Kenya Industrial research and Development institute
KARI	-	Kenya Agricultural Research Institute
KEMRI	-	Kenya Medical Research Institute
KenInvest	-	Kenya Investment Authority
KEPHIS	-	Kenya Plant Health Inspectorate Services
KIPO	-	Kenya Industrial Property Office
KIPI	-	Kenya Industrial Property Institute
LSTHM	-	London School of Tropical Hygiene and Tropical Medicine
NCST	-	National Council of Science and technology
NIH	-	National Institutes of Health
NIMRI	-	National Institute of Medical Research
NTB	-	Non-Tariff Barriers
OAPI	-	African Intellectual Property Organization
OHIM	-	Office of Harmonization for the Internal Market
PCT	-	Patent Cooperation Treaty
PBR	-	Plant Breeder's Rights
PhRMA	-	Pharmaceutical Research and Manufacturers of America
R&D	-	Research & Development
TDR	-	Tropical Diseases Research, Geneva
TNC	-	Trans National Corporations
TRIPS	-	Agreement on Trade Related Aspects of Intellectual Property Rights
UN	-	United Nations
UNCTAD	-	United Nations Conference on Trade and Development
UNESCO	-	United Nations Education Scientific & Cultural Organisation
UNICEF	-	United Nations International Children Education Fund
UNIDO	-	United Nations International Development Organisation
UPOV	-	International Union for the Protection of New Plant Varieties
ITROMID	-	Institute of Tropical Medicine and Infectious Diseases
USAID	-	United States Agency for International Development
USAMRMC	-	US Army Medical Research and Material Command
WAITRO	-	World Association of Industrial and Technological Research Organization
WHO	-	World Health Organization
WIPO	-	World Intellectual Property Office
WRAIR	-	Walter Reed Army Institute of Research
WRP	-	Walter Reed Army Project
WTO	-	World Trade Organization

ABSTRACT

Intellectual property (IP) was, until recently, the concern for specialists and producers of intellectual property rights (IPR). However, the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) concluded after the Uruguay Round negotiations signaled a major shift in this regard. The incorporation of IPR into the multilateral trading system and their relationship with several key public policy issues has elicited debates and concern over their role in socio economic development. Developing country members of the World Trade Organization (WTO) no longer have the policy options and flexibilities developed countries had in using IPRs to support their national development.

In an effort to determine TRIPS significance, adoption and suitability in Kenya, this study examined the implementation of IPR policies at selected public research institutions for agriculture, health, and industry, namely Kenya Agricultural Research Institute (KARI), Kenya Medical Research Institute (KEMRI), and Kenya Industrial Research and Development Institute (KIRDI) respectively. It highlights their technological inventions and innovations, IPR applications/status and subsequent socio-economic contributions and benefits.

KARI, KEMRI and KIRDI were purposely selected for survey as the primary targets of the study due to their importance in the social and economic development of the country, and the combined investment by the Government and donors in support of their activities. Data on inventions/innovations, IP applications, institutional capacity and benefits were sourced from library research and interviews with key informants including officials at the selected and other related institutions. The study adopted a qualitative analysis technique to arrive at the thesis, using the theoretical perspective of entrepreneurial development championed by Schumpeter. The theory specifies the role of policy on technological innovations, protection, trade and economic development, and propounds the influence of innovation on economic development through entrepreneurial initiatives to pursue profits through protected technological innovations to ensure returns on investment.

The findings indicate that there is some effort at adopting and implementing IP protection in all the three institutions with mild success in both KARI and KEMRI, but low implementation at KIRDI. With the exception of KEMRI that has developed and institutionalized an IPR policy though not adequately utilized, IP policies are yet to be adopted at these institutions leading to continued loss of benefits that could have accrued. The study notes that these institutions lack funds for R&D and IP related matters and that most R&D is done in collaboration with external partners that more often than not dictate the course of the research and the adoption and utilization of accruing IP. An important observation was the bottom heavy human resource structure at the three institutions, directing the scarce R&D resources to recurrent expenditure. Societal and economic benefits were observed resulting from the inventions and innovations undertaken at the institutions, with those with the potential for protection indicating remarkable benefits.

The study concludes that higher investment levels and adequate institutional capacity influence R&D, innovation, benefits and IP protection in Kenya, noting from the findings that, under the TRIPS agreement, technological inventions and IP protection are more promising where institutional capacity and collaboration is well developed. Furthermore, taking cognizance of the fact that most innovations in vital sectors of Kenya's economy are undertaken by public sector research institutions mandated and funded by government, thus best suited to develop technologies tailored for Kenya's socio economic needs, the study calls on government to put in place appropriate and suitable policies to promote R&D and IPRs.

1 CHAPTER ONE

1.1. INTRODUCTION

Both developed and developing countries have placed considerable emphasis on the influence of knowledge creation, technology and innovations on economic progress. This has led to the development of national legislations, administrative arrangements and policies to protect IPR, considered necessary to promote technological innovation, industrial and socio-economic development and incentives for private sector investments.

One of the results of these developments has been the strengthening of IPR regimes through the international debate and adoption of minimum standards constituted in the TRIPS Agreement, one of the multilateral agreements under the WTO which succeeded the General Agreement on Tariffs and Trade (GATT) in 1994. The Uruguay Round (1986-1994) that established the WTO was launched at Punta Del Este (Uruguay) in 1986. It dealt with many issues such as trade in goods as well as new issues such as trade in services, investment and intellectual property. IP issues were covered by TRIPS, enacted in this round. The WTO Agreement was adopted in Marrakesh, Morocco, on April 15, 1994 and came into force with respect to developed countries on January 1, 1996. Kenya and other developing countries had up to January 1, 2000 to comply, while least developed countries, including Uganda and Tanzania had until 2006.

The Agreement recognizes the role of technology in socio-economic development, and provides the criteria and objectives regarding the contribution that the protection and enforcement of IPR should make to the promotion of technological innovations and transfer and dissemination of technology."[1] It establishes the minimum standards governing the availability, scope and use of IPR, as well as the procedures and remedies for their applications, and allows member countries to guarantee higher protection of IPR than is provided by the TRIPS Agreement, as long as they are within the provisions of the Agreement.

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[1] United Nations Centre for Trade and Development, (1996). *The TRIPS Agreement and Developing Countries*, United Nations, New York. p7

IPR as a substantive issue was brought into the WTO prompted by US trade activities. In the 1980s the US developed domestic policy and legislation to protect its trade and IP interests, culminating in the 1988 Omnibus Trade and Competitiveness Act under which the US Trade Representative could trigger sanctions against a state whose trade policies and practices harmed US interests. The US, Japan and the European Community (EC)[2] states emphasized the link between IP and trans-national trade, arguing that weak or no protection of IP constituted a Non-Tariff Barrier (NTB) to trade. These developments consolidated a policy shift instituted earlier by the International Monetary Fund (IMF), the World Bank as well as Kenya's and Africa's bilateral development partners in the early and mid 1980s, whereby, trade would replace aid in a context of extensive economic restructuring and aid to states receiving Breton Woods support would be pegged on strengthened IP.[3]

TRIPS emphasize the link between intellectual property and trade as understood in liberal economics. While those who oppose TRIPS argue that it is illegitimate because there is no link between trade and IP, the proponents counter-argue that IP has always had a link with trade, citing the fact that patents have always provided exclusive rights to control the manufacture and distribution of patented products, and that the term *trade* marks were affixed on pots and other items to identify their source in the course of trade.[4]

Liberal economists since Adam Smith have taught that free trade is beneficial because it removes the inefficiencies associated with restrictions such as tariffs. On the other hand, intellectual property primarily operates from the premise that in the absence of restriction or exclusivity, intellectual products will not be produced, especially where producing the first unit is costly but subsequent units can easily be produced through copying or reproduction.

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[2] The EC has been restructured, expanded, and renamed the European Union (EU).

[3] Ben Sihanya, *Intellectual Property and Innovation in Africa: Transferring Technology for Sustainable Development* (forthcoming, 2003).

[4] Ben Sihanya, *Constructing Copyright and Creativity in Kenya: Cultural Politics and the Political Economy of Transnational Intellectual Property*, Ph.D. Dissertation, Stanford Law School, 2003.

While TRIPS is objectionable to many developing countries, it is a welcome relief to developed countries and Trans National Corporations (TNCs). Those who support it point out that TRIPS establishes for all WTO Member countries a detailed set of substantive minimum standards governing the availability, scope, and use of intellectual property rights; it specifies an equally detailed set of civil and criminal enforcement obligations, including border measures, which all WTO Member Countries must implement; it establishes certain procedural requirements governing the administrative acquisition and maintenance of intellectual property rights; and finally, it incorporates by reference a new GATT/WTO dispute-settlement process for the resolution of any disputes between WTO Member Countries over the implementation of the TRIPS Agreement.[5]

The developing countries generally considered the management and control of patent-related activities as a key element in development policy. They tended to see patents as an obstacle to the transfer of technology which they needed for food production and storage, health management, industrialization, and environmental conservation, and as the engine for their development to the level of ability to undertake research resulting in patentable inventions. In contrast, some TNCs and developed countries generally regard the existence of an effective patent protection system as the necessary prerequisite for investment in R&D and the engine for securing the benefits of their strategic and competitive advantage in technology, innovation and R&D.[6]

It has been variously pointed out that TRIPS was essentially drafted and lobbied mainly by the Northern software, pharmaceutical and entertainment TNC so as to secure the benefits of their inventions and innovations internationally through the enforcement of IP rights. Their main argument was that they were losing millions of dollars to counterfeiting and piracy in international trade and investment especially in developing

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[5] Paul Goldstein, *International Intellectual Property Law* Foundation Press New York, 2001, at p. 96.

[6] UNCTAD, *The Relevance of Recent Developments in the Area of Technology to the Negotiations on the Draft International Code of Conduct on the Transfer of Technology* TD/CODE TOT/55, UN, New York, 1990; Carlos Primo Braga, "The developing country case for and agains intellectual property protection" in Wolfgang E. Siebeck (ed) *Strengthening Protection of Intellectual Property in Developing Countries* 112 World Bank Discussion Papers, 69-87 (1990). An edited version is reproduced in Paul Goldstein, *International Intellectual Property Law: Cases and Materials* Foundation Press, New York, 2001, at 64-81. cf. A.O. Adede, *The Political Economy of the TRIPS Agreement: Origins and History of Negotiations*, pp. 10-13.

countries. LDCs generally opposed TRIPS arguing, among others, that bio-patents would limit access to drugs. Unfortunately there was low participation by African countries in the process that led to the TRIPS Agreement because of limited financial, human and technical resources.[7]

The TRIPS Agreement has been widely criticized for being used as a protectionist instrument to promote corporate monopolies over technologies, seeds, genes and medicines. While early intellectual property laws such as those on patents were designed to protect product of the inventive genius who worked on his project in the attic or basement, technological advances have now become the recluse of industry with well equipped laboratories...(the) big corporate firms have taken over inventive activity from the inventor and increased their share of intellectual property portfolio as they buy the best brains and purchase patents of patentees who are not able to exploit their inventions.[8]

Controversies on IP (particularly the minimum standards under the TRIPS Agreement) surround the subject matter of coverage, the range of rights that the holder of IP enjoys and the equity of international arrangements for the protection of IP.[9] The enforceable minimum standards set under TRIPS include copyright, industrial design, trade-marks and patents – where patents are the most contentious issue. TRIPS states that, "patents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application."[10]

Under the TRIPS Agreement all WTO member countries became bound to grant patents for pharmaceutical products allowing pharmaceutical corporations to set prices of patented medicines at very high levels, keeping them out of reach for many of the world's poor. This obligation did not exist under previous international conventions. When the Uruguay Round negotiations began, more than 50 countries in the world did not grant

[7] Few African countries could secure expert representation in the numerous negotiating sessions and committees.
[8] Kameri-Mbote, 2005:1
[9] Ibid.
[10] http://www.wto.org/english/docs_e/legal_e/27-TRIPS_03_e.htm

such protection, thereby enabling the commercialization of low-cost, non-patented products. In addition, the Agreement obliged Members to reinforce rights conferred under process patents, and to protect – against unfair commercial use – the information submitted for the marketing approval of drugs. The new obligations also included granting patent protection for at least 20 years from the date of application, limiting the scope of exemptions from patent rights and obligations, and effectively enforcing patent rights through administrative and judicial mechanisms.[11]

TRIPS grant the corporations monopoly rights that allow them to suppress competition from alternative, low-cost producers. This prevents African and other developing countries from effectively addressing imminent health problems, such as HIV/Aids, malaria and other infectious diseases.[12] These rules dramatically changed the legal framework for the production and commercialization of and access to drugs in developing countries, despite the fact that the TRIPS Agreement provided certain leeway for member States to adopt measures to mitigate the monopolistic rights conferred by patents and promote competition. Such measures, which may lower prices and increase access to drugs include, notably, *compulsory licenses*, that is, authorization by the State to a third party to exploit a patented invention, generally against a remuneration to the patent holder; *parallel imports* of patented products when they are obtainable in a foreign country.

Also at the heart of the debate around TRIPS lies the threat to food security, farmers' livelihoods and sustainable farming practices by patenting of seeds and genetic resources. The controversial article 27.3(b) of the TRIPS agreement allows for patenting of life forms. Farmers using patented seeds are deprived of their right to re-use exchange and sell their seeds in local markets. The control over seeds has shifted from the farming communities to multinational corporations, such as Monsanto and Syngenta that

[11] UNCTAD-ICTSD, (August 2003) Project on IPRs and Sustainable Development
[12] EcoNews Africa, (August 2003). WTO: Trading Away Africa, TRIPS- A threat to Affordable Medicines & Biodiversity. p1

increasingly monopolize the seed market.[13] Kenya, prompted by these concerns affecting it, submitted a proposal to WTO in August 1999, on behalf of the African Group, in preparation for the Seattle Ministerial, with concrete suggestions for reform of the TRIPS agreement. The African Group demanded for example a substantive review of Article 27.3 (b) and that no life forms and living processes may be patented. The proposal gained broad support from other developing countries as well as civil society around the world, but till today there has been no reform of the TRIPS agreement.

Another concern that has been argued to have an effect on Kenya is that TRIPS is facilitating the theft of biological resources and traditional knowledge (so called biopiracy). The imposition of patent rights over biological resources and traditional knowledge deprive communities of their rights to and control over the resources that they have been using for generations. This contradicts the key principles of the UN Convention on Biological Diversity (CBD). African countries have kept demanding that TRIPS rules must be made consistent with the CBD provisions on national sovereignty and benefit-sharing with regards to access to genetic resources and traditional knowledge.[14]

A notable disquiet over IP protection by African countries extension, Kenya, concern limited technological capability these countries have.

> The statistics available indicate that most patent applications emanate from North America and Europe while Africa accounts for less than two per cent of the total patent applications.[15]While African countries have invested in establishing IPR regimes, there is little evidence that these have impacted on the development of individual countries. The argument the IP contributes to development has not been proved in most African countries which have had IPR regimes dating back to early 1900s. Indeed discussions have been around the issues of their being barriers to access to proprietary technology necessary for development and more recently to essential medicines necessary to contain prevalent diseases such as HIV/AIDS.[16]

[13] EcoNews Africa, (August 2003). WTO: Trading Away Africa, TRIPS- A threat to Affordable Medicines & Biodiversity. p1
[14] EcoNews, 2003:2
[15] See Kameri-Mbote, 2005
[16] See Kameri-Mbote, 2005

Kenya is likely to gain least and lose most from the strict IP policy, legislation and enforcement required under TRIPS because it is not cushioned from its adverse effects of higher prices for patented products and technologies, yet they are likely to gain little by way of technology transfer and development.[17]

Even though Kenya was very much aware of these effects of adoption of the TRIPS agreement, it has consistently participated in it like other developing countries due to attractive trade-off incentives package that were presented to them including possibilities for improved market access and trade benefits that would result in gains in areas of agriculture, textiles and clothing, tropical products and safeguards.[18] Similarly, Kenya together with other developing countries recognized the benefits of a multilateral resolution of the differences in the IP area. They felt that unlike bilateral concessions, multilateral trade negotiation framework was better designed to provide credible dispute settlement mechanisms.[19] It was therefore felt by the developing countries that the regime would have reasonable prospects for discouraging the unilateral use of trade channels and instruments by the developed states for extracting concessions on IP, and that it would ensure that trade conflicts relating to IP issues would be handled objectively and effectively.[20] Again, these countries increasingly saw a higher degree of protection of intellectual property as an important part of the general move in many countries towards more open, market-based economic policies and towards increasing interest in attracting foreign investment.[21]

The Kenyan parliament enacted the Industrial Property Act in 1989 (IPA 1989) that established the Kenya Industrial Property Office (KIPO). It provides for, among others, the patenting of life forms, which before 1989, was not possible in Kenya. Patents could

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[17] Lall in *BRIDGES*, Year 6 No. 3, pp. 13-14.

[18] *Ibid.* Subsequently, developed countries have reneged on some commitments, and have adopted essentially protectionist, anti-free trade, anti-WTO policies. An example is US protectionism in textiles and Europeans subsidising their farmers.

[19] This was particularly urgent with the enactment of the US Super 301 under the Omnibus Trade and Competitive Act of 1988 under which the US could take unilateral retaliatory action against a country which it felt was not protecting its IP or general trade interests adequately. The enabling legislation was Omnibus Trade and Competitiveness Act, 1988 which amended the Trade Act, 1974.

[20] Adede *ibid.*

[21] UNCTAD *The Relevance of Recent Developments in the Area of Technology to the Negotiations on the Draft International Code of Conduct on the Transfer of Technology, op. cit.*; cf. Adede, *ibid.*

only be granted in the UK and registered and protected in Kenya. Similarly, the Copyright Act 1966 and the Trade Marks Act, Cap. 506 were essentially modeled on British IP law. This indicates that like other developing countries, Kenya was following in the foot steps of the developed economies, the benefits of which though are debatable.

Kenya, as a country member of the WTO, was required to have fully complied with TRIPS by 1st January 2000, except for obligations concerning national treatment and most favored nation treatment. It has domesticated the TRIPS Agreement through strengthening IP offices as a means of enforcement. These offices include the Kenya Industrial Property Institute (KIPI), initially established in 1990 as the Kenya Industrial Property Office (KIPO) and the Copyright Office in the Attorney General's Chambers. In terms of legislation, Kenya has enacted TRIPS compliant laws including the Industrial Property Act, 2001 (IPA 2001), it had amended the Trade Marks Act to conform to TRIPS, and the Copyright Act, 2001 which came into force on 1st February 2003, in essence creating the Kenya Copyright Board to implement the law. The TRIPS compliant laws have created opportunity for enforcement through litigation and prosecution in the courts of law in cases of infringement.

1.2. STATEMENT OF THE PROBLEM

Intellectual Property Right protection spurred innovations and inventions in the developed countries where it has had a long implementation history. This has in turn led to rapid technological advancement in these countries because the inventors/innovators have been able to not only enjoy the benefits that accrue from such ownership, but also recoup the costs of research (often running into billions of dollars) and hence enabling the entrepreneur to conduct more research and development.

On the other hand, the legacy of colonialism in developing countries like Kenya was such that the colonies were sources of cheap raw materials that only required rudimentary tools to extract. Even in plant breeding, most of the breeds were imported already patented. The colonies therefore depended wholly on imported finished technology. With political independence came the urgent need to industrialize in order to gain economic

independence hence the emphasis by the various country development plans on research and development. However, in most cases it only ended there-in the development plans. Indeed, adequate attention has not been given to systematic documentation of innovations and technological advancements and their contribution to economic growth. The policy documents have only tended to highlight the importance of R&D in general terms.

For IPR to be claimed there must be R&D either by the public or private institutions and/or in collaboration with donors. Most research conducted by the public sector research institutions in Kenya have been at the behest of donor funding and foreigners. This has made the task of claiming IPR for the resulting innovations and innovations a tricky affair. Even during the colonial era, research, especially in the agricultural sector was robust especially by the white settlers.

Implementation of IPR regimens in institutions requires both highly skilled human and adequate financial resources. However, Kenyan government budget allocation has for a long time emphasized more on recurrent expenditure as opposed to financing research and development. Furthermore, human resource infrastructure in these institutions is often administration and support heavy, hence few inventions and innovations to apply for the IPR ownership. Despite the fact that there have been laws since the colonial times regarding some forms of IPR, enforcement of the IPR rules like in other sectors is still wanting. These factors, among others have resulted in the dearth of innovation and invention and their subsequent ownership in these institutions.

Within the Kenyan public, the concept of IPR is still a novelty because most African cultures and traditions tended to be community orients, hence never looked at intellectual property ownership as an issue that could be tapped for economic benefit. As a result, free breeding of plants and animals, exchange of seeds that do well and medicinal herbs and plants is still the order of the day. However, there is limited awakening to the potentials that could be accrued if IPR rights were accessed, registered and enforced. Similarly, through the work of some NGOs and the civil society movements in general,

the public attention is being drawn to the possible adverse effects of blind adoption of TRIPS in Kenya.

Governments of developing countries, NGOs and individuals have expressed their fear that many of the technological advantages they are currently enjoying could be curtailed with the introduction of the new multilateral agreement on TRIPS. They argue that developing countries have limited innovations and weak institutional capacity for IPR protection, and the adoption of stronger IPR as stipulated in TRIPS agreement would encourage dependency on imported technologies with substantially prohibitive costs in order for the US, EU and other rich countries to keep the developing countries backward, rob them of their biological and cultural heritage among other ills. The pro-strong TRIPS groups on the other hand, argue that those against the treaty should know that for any country to experience technological advancement, transformations have to occur through inventions and innovations, and that adoption of TRIPS would lead to technological advancement and technological transfer to the developing countries.

With these positions in mind, it is critical, therefore, to address the following questions in relation to Kenya: What are some of the innovations that have been made in agriculture, health and industrial sectors as observed from KARI, KEMRI and KIRDI? What kind of IP protection is applied to the observed innovations? Are the institutions implementing IPR policies? What are the socio-economic benefits derived from the innovations and IPR adoption? What policies and policy recommendations ought to be put in place to increase returns from innovations and IPR adoption? What are the key concerns surrounding the issues of IPR for public research institutions? What are the specific difficulties they face in intellectual property implementation? Policy makers need to address these essential questions in order to be able to design R&D and IPR laws and policies that best meet the needs of the Kenyan people.

This study therefore seeks to identify the contribution of technological innovations in various sectors of the economy, with a specific emphasis on those undertaken by the public research institutions, the level of IP protection on R&D and recommend measures

to be taken by government to improve the innovative capacity of research institutions. The study will also contribute towards filling the information gap that exist in studies on the influence of innovation and IP protection on technological development in Kenya, thus informing on policy.

1.3. OBJECTIVES OF THE STUDY

The general objective of the study is to critically examine the implementation of IPR policies in public sector research institutions and how adoption of TRIPS agreement has influenced them. Specifically, the objectives of this study are summarized as follows:

1. To identify innovations and inventions in selected public research institutions of KARI, KEMRI and KIRDI between 1990 and 2004;
2. To determine the IPR status of the identified inventions and innovations;
3. To examine the influence that TRIPS has had in the implementation of R&D policies in these institutions;
4. To examine the IPR strategies at the research institutions and their achievements so far; and
5. To examine the factors that influence IPR protection in the selected institutions.

1.4. JUSTIFICATION FOR THE STUDY

1.4.1. Policy Level

Developing countries like Kenya realized from the time of independence that technological advancement through innovations and inventions was a prerequisite for meaningful economic transformation from poverty, lack of affordable health care and stagnant or declining economic growth, partly caused by dependency on imported technologies whose costs are substantially prohibitive. The introduction of the TRIPS agreement has resulted into increased cost of imported goods and technology and is as a result of efficient and effective IPR protection regimes in the originating countries, which has acted as a further incentive for more innovations and inventions there. The proponents of TRIPS have consistently argued that since developing countries like Kenya

have limited innovations and weak institutional capacity for IPR protection, if protection of intellectual property rights were to be effected fully, further innovations and inventions would ensue, and hence lead to increased technological advancement in the country.

Several policy documents and sessional papers have been formulated in Kenya[22] to spur industrialization and hence to reduce poverty with little positive results as poverty still remains a major challenge. It is only in the 90s that intellectual property rights started drawing attention of the policy makers as an integral issue that affect technological development, and subsequently economic advancement. Research institutions are only just recognizing the importance of IPR in their endeavor to secure ownership and benefit from their invention and innovation. At the policy level the issue of IPR has been interrogated in an ad-hoc manner, meaning that systematic documentation of innovations and technological advancements, the challenges faced in the process and their contribution to economic growth has not been fully reflected in the policy documents, which have only tended to highlight the importance of R&D in general terms. The research findings herein shall enrich and inform the continued debate on increased adoption of IPR in both public and private sectors, while highlighting opportunities and constraints in the process.

The study shall also contribute to the development of enhanced policy framework for promotion of collaboration between the public research institutions and funding institution/organization, both local and international with regard to the resultant IPR ownership of their joint products.

The study shall also interrogate the issue of TRIPS agreement process in which Kenya is party to. Kenya, just like many other developing countries have not been able to participate in the negotiations effectively, especially in as far as the civil society and other important stakeholders are concerned because of lack of clarity as to what TRIPS portend for Kenya and its people. The government too has been variously accused of

[22] Notably: Industrialization to the year 2020, ERS, Poverty Reduction Strategy Paper, 8th National Development Plan.

being too eager to sign the documents with little care or regard as to its impact on its people. Indeed, Kenya and other developing countries are said to have participated in negotiations without clear policy or negotiating strategy. There was also limited input from critical sections of the political economy such as Parliament, the trade and industrial property institute, and NGOs, apart from the fact that the negotiations have proceeded without sufficient public scrutiny. The study will thus add to the scant information about TRIPS and how different stakeholders could participate meaningfully in it.

1.4.2. Academic Level

Innovations that have been realized in Kenya, the nature of IP protection, and their subsequent contribution to socio-economic development and constraints encountered therein have not been adequately studied. Limited studies have been carried out to determine opportunities and challenges presented by the TRIPS Agreement adopted and enforced in 1995 as a multilateral agreement for IPR, particularly Article 7 on technological innovations and technology transfer.

This study therefore seeks to identify the contribution of technological innovations in various sectors of the economy, the level of IP protection on R&D and recommend measures to be taken by government to improve the innovative capacity of research institutions. The study will also contribute towards filling the information gap that exists in studies on the influence of innovation and IP protection on technological development in Kenya.

1.5. LITERATURE REVIEW

The literature review looks at literature in three main areas, namely literature on applications of IPR in technology transfer and industry, agriculture and health, the nature of R&D undertaken, underscoring the importance that has been placed on knowledge and its protection there from.

1.5.1. IPR AND TECHNOLOGY TRANSFER

Economically advanced countries pursue economic policies that encourage investment in new R&D and develop human capital given that accumulation of knowledge is the driving force behind economic growth. The role of IPR has therefore become significant in economies that place importance on creation, diffusion, and effective use of information and knowledge.

Carlos Braga in a panel discussion at a Tech Net seminar, March 5th 1998 observes that the demand for IPR protection has increased significantly in proportion to growth of knowledge activities over the past decades, noting that the share of value added by knowledge-intensive industries increased from 21% of GDP to 27% between 1982 and 1995 in USA.[23] An increasing number of policy makers in developing economies have recognized the important role of the IP system in encouraging private investment in R&D, especially in the industrial and scientific fields. In India, for example, there has been a steady increase in the level of FDI ever since patent and trademark reform was introduced in the early 1990s.[24] An even more dramatic development took place in Brazil with spectacular growth in FDI following the introduction of a new industrial property law in 1996 (US$4.4 billion in 1995 to US$32.8 billion in 2000).[25]

The TRIPS Agreement recognizes the role of technology in socio-economic development, and provides the criteria and objectives regarding the contribution that the protection and enforcement of IPR should make to the promotion of technological innovations and the transfer and dissemination of technology. Article 7 of the TRIPS Agreement states that: "*The protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations*".[26] Article 66.2 obliges developed countries to provide incentives to their enterprises and institutions to

[23] World Bank Group. (1998). "Intellectual Property Rights and Economic Development: An Agenda for the World Bank Group," TechNet Seminars.
[24] Idris K, 2003:4
[25] Ibid, p5
[26] http://www.wto.org/english/docs_e/legal_e/27-TRIPS_03_c.htm

promote technology transfer to least developed countries in order to enable them to create a sound and viable economic base.[27] The agreement also refers to measures that countries may adopt to protect public health and nutrition and to promote public interest in sectors of vital importance to their socio-economic and technological development.[28]

The arguments concerning effects of IPR on technology transfer, like concerns in all other fields affected by IPRs, is still a North South issue. During the TRIPS Agreement negotiation, developing countries tended to see patents as an obstacle to transfer of technology which they need for their industrialization process as this was (is) the engine for their development to the level of ability to undertake research resulting in patentable inventions. In contrast, the developed countries regard the existence of an effective patents protection system as the necessary prerequisite for investment in research and development and the engine for driving technology transfer."[29] Drawing from the Korean experience, Kim, L (2003), observes that strong IPR protection will hinder rather than facilitate technology transfer and indigenous learning in the early stage of industrialization when learning takes place through reverse engineering and duplicative imitation of mature foreign products. Only after countries have accumulated sufficient indigenous capabilities with extensive science and technology infrastructure to undertake creative imitation IPR protection becomes an important element in technology transfer and industrial activities.[30] It is important therefore to find a balance between access to technologies for adoption and incentives for development of the same through the strengthening of R&D.

It has been argued that technology transfer expands with stronger patents when there is competition between a foreign innovator and a domestic innovator, and a failure to provide IP protection removes the incentive for the foreign firm to license its best-practice technologies.[31] Given that technology owners do not have an incentive to transfer their proprietary knowledge to countries with weak IPR systems in view of the

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[27] Ibid
[28] UNCTAD, 1996:7
[29] Adede, A. 2001:17
[30] Kim, L. (2003). "Technology Transfer & Intellectual Property Rights The Korean Experience." ICTSD, UNCTAD Issue Paper No. 2. Geneva, Switzerland. p vii.
[31] Taylor, M. (1994). "TRIPS, Trade, and Growth," *International Economic Review*, Vol. 35, p361-381

potential for piracy. The crucial issue, therefore, is how IP can facilitate developing countries to gain access to technologies required for development.[32] Gorasia (2002) argues that patents and patent protection systems are the appropriate vehicle for transferring valuable technology to the developing world as the disclosure of technology obtained from patents allows developing countries to obtain and exploit the technology for their benefit.[33] Beier (1980) further notes that it is only patent protection which gives enterprises the necessary incentive to file their important inventions abroad and converts an invention to an object of international trade that can be transferred without too great a risk.[34] Patent-protected imports contribute directly to the transfer of foreign technology, which is subsequently followed by developing indigenous technology through establishing local production facilities.[35]

In summary, considerable attention has been given to the expanding role technology plays in economic development and industrialization. It has been noted that technology transfer from firms in advanced countries can be an important source of new knowledge for firms in developing countries. It is significant to note that the arguments presented rest on the proposition that technology owners do not have an incentive to transfer their proprietary knowledge to countries with weak IPR systems, in view of the potential for piracy and therefore it is imperative for developing countries to develop their IPR regimes in order to attract new and emerging technologies crucial to their own development. The ability of developing countries to improve their R&D capacities to advance technologically is also critical.

It can be concluded from the literature reviewed in this section that technology transfer places emphasis on IPR, however, IPR should not be a constraint to the economic advancement of developing countries through expensive technologies. The TRIPS

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[32] Commission on Intellectual Property Rights. (2002). *Integrity Intellectual Property Rights and Development Policy,* Report of the Commission on Intellectual Property Rights, London. p28

[33] Gorasia, P., (2002). Intellectual Property Dissertation: The Impact of Article 27 of the TRIPS Agreement on Foreign Direct Investment and Transfer of Technology to Developing Countries. p22

[34] Beier, F. (1980). "The Significance of the Patent System for Technical, Economic and Social Progress," in *International Review of Industrial Property and Copyright Law,*p563 & 584

[35] Greif, S. (1979). "The Role of Patent Protected Imports in the Transfer of Technology to Developing Countries," in *International Review of Industrial Property and Copyright Law,* 123, 124

Agreement addresses this challenge by obligating developed countries to provide incentives to their enterprises and institutions to promote technology transfer to least developed countries in order to enable them to create a sound and viable economic base.

Having underscored the importance of technology to development, it will be useful to study in-house development of technology applicable to Kenya, and how investment in R&D efforts, aimed at working on both new and imported technologies, to realize the 2020 industrialization target as set out in the Sessional Paper No. 2 of 1996 are undertaken, their successes, adoption, and IPR implementation.

1.5.2. IPR AND THE AGRICULTURE SECTOR

The role of science and technology in promoting economic growth and welfare improvement is well established, particularly in the field of agriculture and rural development. It is observed that "new technologies can enhance the quantity and quality of agricultural yields and output, while also improving the sustainable use of natural resources, reducing consumer food prices, connecting rural producers to market opportunities, and stimulating the accumulation of physical and human capital for rural households and individuals."[36] These improvements ultimately translate into "higher incomes, greater food consumption, better nutrition and favorable changes in the allocation of individual and household assets, such as improved crop varieties, human and livestock vaccines."[37]

Apart from the direct role in generating incomes and employment, the role of technological change in agriculture has been much discussed by economists and policymakers.[38] Change in technology and institutions in the agricultural sector in developed countries were instrumental in the industrial revolution. These technological changes included "mechanization, use of chemicals, fertilizers, pesticides, and

[36] Naseem, A, Omamo,S. W., and Spielman, D.J (2006). The Private Sector in Agricultural R&D: Policies and Institutions to Foster its Growth in Developing Countries, ISNAR Discussion Paper 6, August 2006, International Food Policy Research Institute. p1
[37] Ibid.
[38] CIPR, 2002:75

herbicides."[39] The National Academy of Sciences observes that the most notable technological innovation in agriculture has been in biotechnology in particular genetic engineering on novel transgenic crop varieties such as soybean, cotton, tobacco, potato and maize.[40] These advancements were as a result of R&D investment by the private and public sector institutions undertaken mainly by developed countries.

In terms of resource allocation and distribution, approximately 30% of global agricultural R&D is spent in developing countries. It is estimated that in 1995 the total expenditure by the public sector on agricultural research in developing countries amounted to $11.5 billion (at 1993 international dollar values) of which private research expenditure amounted to $0.7 billion[41] and $869 million in 2000 (other estimates have put this figure as high as $2 billion).[42] Majority of the research, however, is conducted in the more technologically advanced developing countries of Asia and Latin America, where research expenditures grew at 5-7% annually between 1976 and 1996.[43]

The strengthening of intellectual property rights regimes in some developing countries, particularly with respect to the protection of biological innovations, has improved the ability of firms to appropriate the returns on their R&D investments,[44] whose significance has been realized by the number of agricultural R&D institutions adopting and utilizing IPR.

The Centre for Research on Wheat and Maize (CIMMYT) based in Mexico was the first to embrace IPR in 2000.[45] In 2001, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) established an IPR policy based on defensive patenting.[46] International Livestock Research Institute (ILRI) based in Kenya has put in place a policy

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[39] Moschini, G. (2001). Economic Benefits and Costs of Biotechnology Innovations in Agriculture, Centre for Agricultural and Rural Development, Iowa State University, Iowa. p4
[40] National Academy of Sciences. (2000). *Transgenetic Plants and World Agriculture*, National Academy Press, Washington D.C. p4
[41] CIPR, 2002:83
[42] Naseem, A. et. al. 2006:7.
[43] Ibid
[44] Ibid, p3
[45] Nature. (2000). Vol. 404. p594
[46] ICRISAT. (2001). "Policy of the ICRISAT on Intellectual Property Rights and Code of Conduct for Interaction with the Private Sector," ICRISAT.

for IP protection on its products and technologies, particularly transgenetic technologies.[47] The International Centre for Insect Physiology and Ecology (ICIPE) established its own IP policy which has been put to use, with the signing of a contract with the Diversa Corporation of the US, the Kenya Wildlife Service, and the Department of Biochemistry at the University of Ghana in October 2001.[48] The African Centre for Technology Studies (ACTS) has also advocated for IPR, in the hope that it will allow Africa to compete internationally in biotechnology.[49]

IPR in agriculture is expected to bring agricultural development and increase food production by encouraging private technology transfer and investment in research. However, Kuyek (2002) argues that that "strengthening IPR is an attempt to privatize innovative practices and biological resources in Africa and to reorganize seed markets for the benefit of foreign corporations."[50] It is reported that 97% of all patents are held by nationals of developed countries and 90% of all technology and product patents are held by global corporations.[51] In Kenya, 90% of the commercial vegetable seeds were imported from the EU, USA, and Asia, and over 90% of all PVP applications were from breeders from outside the country[52].

Whereas the world's poor rely for sustenance on crops such as rice, beans, and cassava, which are largely beyond the forms of the private research sector and have modest commercial prospects due to low income elasticities,[53] there has been more support for the European cut flower market in Africa than food security. Private R&D tends to focus on a limited number of commodities with particular traits. "In Asia, for instance, private

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[47] Kuyek, D. (2002). "Intellectual Property Rights in African Agriculture: Implications for Small Farmers," Genetic Resources Action International. p14
[48] Ibid, p15
[49] Ibid, p15
[50] Ibid, p12
[51] United Nations Development Programme. (2000). *Human Rights and Human Development*, Human Development Report 2000, United Nations, New York. p84
[52] Shah, J. (1999). "The Seed Industry in Kenya, an Overview," Presented To The Preparation Meeting For The Establishment of an African Seed Trade Association, 8-10 April, 1999, Lilongwe, Malawi, and Van der Wilt, J., & Jaffe, W. (1995). "Impact of plant Breeders Rights in Developing Countries," Inter American Institute for Cooperation on Agriculture, San Jose and University of Amsterdam.
[53] Pardey, P., Wright, B.D., Nottenburg C., Binenbaum, E., & Zambrano, P. (2003). "Intellectual Property and Developing Countries: Freedom to Operate in Agricultural Biotechnology," in *Research at a Glance*, Biotechnology and Genetic Resource Policies Brief 3, IFPRI. p1

R&D is concentrated in cash crops, such as oil-palm, rubber, tea, vegetables, and horticulture; hybrids of rice, sorghum, millet, and maize; and livestock hybrids, such as poultry. Likewise, private R&D in Latin America tends to focus on hybrid maize...private-sector investment in maize research is approximately twice that of the public sector in both Asia and Latin America. Private research on bananas has also been a main focus for firms in Central America and the Caribbean. For Africa, where relatively little private R&D is conducted, the focus has been on export commodities such as tea and coffee."[54]

In Kenya, only one variety (developed by the private sector as of 2000) out of the 136 applications filed and tested since 1997 has been in a food crop, while more than half were for roses.[55] In Zimbabwe, as of 1999, only 30% of all applications were in food crops, and in South Africa, where 1,435 PVP grants were issued by the end of 1998, more than 40% were for ornamental varieties.[56] This indicates that a high concentration of key technologies protected as IP are in the hands of a small number of large, multinational corporations based in Northern America and Western Europe, which could pose as a food security risk, if R&D in food crops is not strengthened in developing countries.

From the literature examined, the expected potentials of IPR include improvement of commercial, industrial, economic and social development in developing countries including enhanced market access, more local R&D, increased Foreign Direct Investment (FDI) and technology transfer. The anticipated challenges include higher prices for protected products and restrictions in developing production capabilities through imitation, privatization and monopolistic tendencies. The literature has clearly indicated the importance of IPR, however, the concentration of R&D is in economically viable crops whose returns on investment from international markets are an incentive to invest, while little attention is given to food crops, and if given, is on hybrid crops which require farmers to repurchase seed for every successive planting. This poses a challenge for

[54] Naseem, A. et. al. 2006:9-10
[55] Cullet, P. (2001). Plant Variety Protection in Africa: Towards Compliance with the TRIPS Agreement, African Centre for Technology Studies, Nairobi. p12
[56] Wynand, 2001

countries to encourage R&D in this field. Kenya has tremendous potential to undertake R&D in this sector, and the public R&D institution has contributed through technological innovations. However, there is need to develop an IPR policy to guide in its R&D development and use, as it is largely supported by donor agencies who may own technologies ensuing from its funding.

1.5.3. IPR AND THE HEALTH SECTOR

More than 85% of the world population lives in developing countries, with the majority having limited or no access to drugs that is abundantly available in the developed nations.[57] Statistics indicate that above 25 million people in Africa are living with HIV/AIDS, amounting to nearly 70% of infected adults and children worldwide[58] posing enormous threat to development given that alarming rise in HIV infections has come with a corresponding decline in life expectancy in the region. A study by the UNDP shows that life expectancy has dropped in southern Africa by 29 years on average because of HIV/AIDS.[59] Of these people, less than 4% had access to antiretroviral drugs by the end of the year 2001.[60]

South Africa has an estimated population of some 5.3 million people living with HIV/AIDS. This figure equates to more people living with HIV/AIDS than can be found in north and Latin America, the Caribbean, Western and Central Europe as well as Oceania combined....a country like Swaziland for instance, saw its HIV prevalence rate escalate from a 4% infection rate in 1992 to a staggering 38.8% amongst sexually active adults in 2004, a mere 12 years later.[61] It is important to bear in mind that although most attention is correctly focused on HIV/AIDS, other pandemics such as malaria and tuberculosis are still rampant across the sub-region. Of the estimated one million malaria

[57] Elliott and Bonnin 2002
[58] UNAIDS, 2002:8
[59] Avafia, T. (2005). TRIPS and Public Health: The Unresolved Debate, tralac Trade Brief No 2, June 2005. p1
[60] Sun, H. (2003). Reshaping the TRIPS Agreement Concerning Public Health: Two Critical Issues, WTO Research Center, Zhejiang University. p3-4
[61] Avafia, *Ibid*, p1

deaths that occur yearly on the globe, approximately 90% of them occur in Africa, with young children the most vulnerable sector of the population to disease.[62]

Available literature shows that there has been inadequate R&D on diseases that affect developing countries. Between 1975 and 1999, more than 1,400 new chemical entities were marketed, of which 379 were considered therapeutical products, only 13 (1%) of these products were specifically for tropical diseases and three were for tuberculosis.[63] Similarly, less than 5% of the money spent worldwide on pharmaceutical R&D is for diseases that are predominant in developing countries, and that in 2002 the world drug market was valued at $406 billion, of which developing world accounts for 20% with low income countries having much less.[64] The concern about insufficient R&D on "neglected diseases" and "poverty – related diseases" was also noted by the world health assembly, in their 56th meeting in May 2003.[65]

Low levels of R&D in developing countries can be attributed to considerably limited amounts of funds and donor dependence, as the national budgets cannot sustain research. The Global Forum for Health Research indicated that public sector spending on health research was estimated to be $37 billion in 1998, of which $2.5 billion was spent in low and middle income developing countries and that in 2001 the US National Institutes of Health (NIH) accounted for over $20 billion.[66] In addition, it estimated that charitable foundations spent $6 billion and World Health Organization's (WHO) Special Programme for Research and Training in Tropical diseases received only about $30 million annually. The exact proportion of public sector spending on diseases relevant to developing countries has not been authoritatively estimated, but seems unlikely to be higher than 10%.[67]

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[62] Avafia, *Ibid*, p1
[63] Borrell, J. & Watal, J. (2002). *Impact of Patents on Access to HIV/AIDS Drugs in Developing Countries* CID Working Paper No. 92, Centre for International Development, Harvard University, Cambridge MA. p3
[64] CIPR, 2005:42
[65] WHA56.27, Agenda item 14.9
[66] Global Forum for Health Research, 2002
[67] Global Forum for Health Research, 2002:107

The cost and returns have been reported to be the determinant of innovations in the health sector. "The concentration of R&D in the private sector on diseases that do not affect developing countries is driven by the expected returns, and purchasing power of developed countries which represent nearly 90% of global pharmaceutical sales...most of the R&D investment, estimated at US$24 billion for 1999 for instance, was made possible largely because of the existence of an IP protection system."[68] It is estimated that the pre-tax cost of developing one drug first marketed in the early 1990s was US$500 million.[69] Industry estimates show that only three out of ten approved drugs recoup average R&D costs and firms are forced to rely on successful drugs to fund new ones. This is what propels these companies to protect their innovations.

The reviewed literature indicates that a substantially larger portion of the world population live in developing nations, where the rate of inventions and innovations in the health sector is substantially low and is supported mainly by donor funds. R&D is concentrated in the developed countries where there is purchasing power. Due to the cost of developing the innovations, most R&D institutions in the developed countries protect their discoveries. This calls for R&D to be intensified by the public research institutions to meet the needs of the developing countries health care. It is indicated, however, that placing the outputs of publicly funded research in the public domain is not sufficient to generate social and economic benefits from research. There is need therefore to establish how public research institutions in developing countries can contribute to effective technological innovations in keeping with the TRIPS provisions.

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[68] Pharmaceutical Research and Manufacturers of America. (1999). *PhRMA Industry Profile, 1999*, PhRMA, Washington, DC. p16

[69] PhRMA, p24

1.6. THEORITICAL FRAMEWORK

The theoretical perspective that has been considered and applied in the study is Schumpeterian theory of entrepreneurial development as it specifies the role of policy on technology innovations, protection, trade and economic development.

Entrepreneurship, which consists in the creation of a previously-unperceived opportunity for profit and the alertness to that previously unutilized opportunity, and taking action to achieve the opportunity[70] was seen by Joseph Schumpeter as important for technological change. Schumpeter was among the first twentieth-century economists to advocate for the fundamental importance of technological change in modern capitalist economies, and was the first scholar to develop the theories of entrepreneurship.

Schumpeter argued that the innovation and technological change of a nation comes from the entrepreneurs "the dynamic agent of change, the catalyst without whom no increase in physical, natural, or human resources can be transformed into a productive increase," [71] which consist of government, state corporations, multinationals, corporative ventures, private firms and/or individuals. Schumpeter stresses that large companies with resources and capital to invest in R&D are the movers of innovation and economy.[72]

Schumpeter saw innovations as the engine of economic development[73] given that entrepreneurs in pursuance of profits devote available resources to innovation of new technologies that would be competitive and increase returns, and protect them through applications of patents, copyrights, trademarks and trade secrets in anticipation of economic gains, generating economic efficiency and maximization of economic wealth. These innovations include new innovative products, new techniques of production, opening of new markets, opening of new sources of supply, improvement of management

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[70] Wood, J. S. (2005). "Development and Present State of the Theory of Entrepreneurship in Product and Asset Markets," Austrian Scholars Conference March 19, 2005, Austrian Concepts and the Mainstream. p7

[71] Schiavo-Campo, S., & Singer, H. (1970). *Perspectives of Economic Development*, Houghton Mifflin Company, Boston. p50

[72] http://www.minotstateu.edu/econ/drhuenneke/schumbiz.html, http://en.wikipedia.org/wiki/Joseph_Schumpeter#Schumpeter_and_Entrepreneurship

[73] Elser, 1983:112

techniques and improvement of distribution methods. Schumpeter emphasized the interruption of previous market processes - the disruption of existing equilibrium - by the new innovative production processes[74] reflecting technical progress.

According to Schumpeter, innovating occurs in periodic clusters of activity whereby the activity of the first innovators and the profits that they show from their risk and toil attracts what Schumpeter calls "a swarm of imitators," which dampens down the profits of the innovators, but also increases output in that industry-this is what calls for IP protection.

Schumpeter's work emphasized three principles that: (1) innovations continually upset established relationships in markets and organizational structures through a process of "creative destruction"; (2) technological innovation provides the opportunity for temporary monopoly profit and; (3) large monopolistic firms are the prime source of technological innovation because they are best able to bear the high costs of technological innovation.[75]

Scherer and Ross[76] and Kamien and Schwartz[77] point out that "although economists who study innovation generally accept Schumpeter's first two principles, most empirical studies of the relationship between market structure and research and development expenditures reject the linkage between monopoly power and disproportionately large investments in innovation...(noting that) what is needed for rapid technical progress is a subtle blend of competition and monopoly, with more emphasis in general on the former than the latter, and with the role of monopolistic elements diminishing when rich technological opportunities exist."[78]

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[74] Wood, 2005: 35
[75] Mergers, 1988:843
[76] Scherer, F., & Rose, D. (1990). *Industrial Market Structure and Economic Performance, (3rd edn),* Houghton Mifflin, Boston. p614-660
[77] Kamien, M., & Schwartz, N. (1982). *Market Structure and Innovation,* Cambridge University Press, Cambridge. p49-104
[78] Scherer and Ross, 1990: 660

Schumpeter[79] observes that competition is a process of 'creative destruction' in which deadwood in the economy is cut out by dynamic firms raising overall productivity by innovation, thus reducing prices and driving out more costly firms. In this process, leaner fitter firms succeed less able ones; new technologies and products replace old ones. These firms may well be monopolies because, according to Schumpeterian theories, monopolies are more likely to undertake R&D expenditures and adopt innovations than firms in competitive markets. This process of competition, emphasized by Schumpeter, is better suited to a dynamic analysis of an economy that is developing and growing through innovation and technical change that give rise to the case for patents and copyrights and other IPRs.

Kilby,[80] Screpanti and Zamagni[81] maintain that capitalistic systems involve competing firms each trying to make profits by dynamic choice of innovative strategy, the competitive process triggers economic growth through continued destruction of old innovations and creation of new innovations. "This process creates investment opportunities arising from the new products and/or new markets. The rapidly shortening life-cycle of new products raises the importance of getting a sufficient lead time on competitors. If costs have to be recovered in a relatively short period, other things being equal, the strategy of relying solely on being first to the market in order to capture the returns on the research investment become less attractive."[82]

With the use of an invention/innovation in production, benefits will accrue which stem from the fixed costs that went into the development of the technology. This is the defining characteristic of technology, examples of such innovations include new productive methods, which allow production of a given good at a lower cost than the competitors, or exploiting a new market, a new product, a new source of raw materials, or a new organizational method. "Income from such innovations is essentially a monopoly rent and is temporary; competition therefore, induces diffusion of innovations that have

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[79] Schumpeter, Joseph A. (1930). Business Cycles: a Theoretical, Historical and Statistical Analysis of the Capitalist Process, McGraw –Hill, New York and London. p774-777
[80] Kilby, P. (ed) (1971). *Entrepreneurship and Economic Development*, the Free Press, New York. p44
[81] Screpanti and Zamagni, 1993
[82] Ibid, p244

been made and, with it, the gradual elimination of the entrepreneur's differential earnings. The temporary advantages arising from the innovation become benefits of the entrepreneur, but the society has drawn a permanent advantage from the innovation in the form of a reduction of prices or an increase in the range of products available."[83]

Studies carried out with Schumpeter's model have reported positive association between levels of investment and major innovations, "it is estimated that 16% of all capital formation in 1920 was associated with innovation in automobiles and related industries."[84] Schumpeter[85] reported that "the automobile changed completely the conditions of life for the people and there was scarcely a firm or household that did not feel its effects. Not only were countless investment opportunities opened for suppliers, dealers, garages, repair shops, taxi services, bus lines, filling stations, tires and tubes and so on almost without end, but a whole agricultural revolution was only part of the picture. Steel, copper, rubber, glass, railroad transportation and automobile insurance were directly stimulated; and a great volume of construction, both industrial and domestic induced."[86] It is expected that developing countries can obtain similar achievements in adoption and application of IPR to strategic innovations with greater multiplier effects.

The initial Schumpeterian perspective of entrepreneurship development has been adopted and refined as part of the evolutionary theory with analytical detail and empirical applications to explain the rate of technical change, market structure as an endogenous variable, factor bias of technical change, relative importance of innovation and, imitation in technical change.

Schumpeter's theory, while stating that innovation influence economic development, explain entrepreneurial initiatives to pursue profits through technological innovations which are protected for returns on investment. "Commercial exploitation of scientific ideas always requires a substantial amount of investment whose profitability is

[83] Screpanti and Zamangi 1993:244.
[84] Terborgh, 1945:87
[85] Schumpeter, 1930
[86] Ibid, p774-777

determined by the institutional, legal and economic environment which affect the pace and direction of technological change. Even in the less developed countries where technical knowledge would seem to be available off the shelf, learning to use that technology is far from costless and the rate of dissemination reflects the institutions' property rights regime and pricing structure that together determine the private profitability of acquiring knowledge."[87]

Schumpeter's theory of entrepreneurial development will be utilized in testing this study's hypothesis that institutional capacity, investment levels and IP protection influence R&D.

1.7. STUDY HYPOTHESES

In order to address the set objectives of this study, three interrelated hypotheses were examined:

1. The public research institutions in Kenya lack the capacity to implement and benefit from the intellectual property rights (IPR) as contained in the Trade Related Aspects of Intellectual Property Rights (TRIPS) agreement.
2. The public research institutions in Kenya are over reliant on support from donors and collaborators and can therefore not effectively claim IPR and accruing benefits from the inventions and innovations.
3. Protected innovations will have higher returns and greater social and economic gains.

[87] Grossman, G.M., and Helpman, E., (1993). Endogenous innovation in the theory of growth, NBER Working paper series, working paper No. 4527, National Bureau of Economic Research, Massachusetts. p6

1.8. RESEARCH AND METHODOLOGY

This section outlines the methodology, research design and data collection used in the research process of the study.

1.8.1. CASE SELECTION

The selection of the case studies focused on innovations that have been realized in KARI, KEMRI and KIRDI, Kenya's leading research institutions for agriculture, health, and industry respectively. It is important to mention that these are not the only research institutions available in Kenya, there are hundreds of organizations which are involved in research in the selected sectors presently. Likewise, and as indicated in the review of literature, there are many innovations that have occurred in both public and private sector as well.

KARI, KEMRI and KIRDI were purposely selected as the primary targets of the study for three main reasons, one; they are the leading R&D institutions in the targeted sectors established through acts of parliament, second; the combined investment by the Government and donors to these institutions, third; their importance in the social and economic development of the country, given their collective contribution to food security, poverty reduction, health and safety, industrial transformation, technological advancement, employment generation and domestic and export earnings among others that contribute toward the country's economic development.

1.8.2. RESEARCH DESIGN

The study design was use of surveys and census methods. The variables that were examined in this study were reported innovations, IPR implementation, benefits and institutional capacity. In this respect, the study utilizes innovations with profiles obtained from authenticated registers and/or inventory of KARI in the case of agriculture, KEMRI in the case of health, and KIRDI in the case of the industrial sector. Data and information was also obtained related agriculture, health and industry institutions relevant ministries

and institutions, including the Ministry of Trade and Industry and the National Council for Science and Technology.

Given the wide range of innovations, a sampling of critical innovations from each sector was important to facilitate in-depth understanding of the R&D and accruing IP on the innovations, as well as their application to commercial ventures. The indicators that were used for these variables are summarized in Table 1 below.

Table 1: Operationalisation of the Variables

No.	Variable	Indicators
1	Reported innovations	Innovations recorded in annual reports and databases of the research institutions
2	IPR adoption/application	• The number of PBRs grants from the Kenya Gazette (2002) which incorporates the grants for 1999, 2000, and 2001 • IPR grants from KIPI data base • PBR grants from KEPHIS register (agricultural products) • Recorded KARI, KEMRI, and KIRDI databases
3	Socio-economic benefit of the reported innovations	• Application and use of the innovations in the country • Revenue generated from particular innovations and related services • Linkages generated by the use of the innovation (industry and general population)
4	Investment	• Direct budgetary allocation to research institutions • Level of investment by collaborating agencies
5	Institutional capacity	• Human resource i.e. scientists/technologists • Number of collaborating agencies

1.8.3. DATA COLLECTION

Secondary Data Collection Method

Secondary data constituted the bulk of the materials used in this research. This data was instrumental in identifying and appreciating the innovations that have been realized in the sampled institutions. The data included materials on the selected institutions' annual reports, the Kenya gazette, economic surveys, library materials (both published and unpublished), books, newspapers, scholarly journals, magazines, articles, reports, electronic journals, scholarly seminar reports, development plans and sessional papers. These were used to obtain statistics related to innovations, socio-economic benefits arising from identified innovations and adoption of IPR at the institutions.

Primary Data Collection Method

Interactive interviews using questionnaires were used to collect primary information that was not available in public records and to gain in-depth understanding of the reported innovations; aspects that influenced IPR adoption and application and overall benefits that have been realized from the innovations. The interviews and discussions were conducted with concerned government officials within the three sampled institutions to identify policy concerns on areas of IP with regard to international trade, investments, trade regimes and R&D. Specific discussions were held with officials from KARI, KEMR1, KIRDI, Kenya Investment Authority (KenInvest), WTO, International Development Law Organization (IDLO) and KIPI. The researcher also discussed IP issues with participants in IP related trainings, seminars, workshops and conferences, and conventions on negotiations of TRIPS under WTO.

1.8.4. LIMITATIONS OF THE RESEARCH

While there have been various innovations since the inception of KARI, KEMRI, and KIRDI, the design of the research and sampling focused on an examination of R&D activities undertaken in the 1990s when the WTO multilateral agreement on IPR (TRIPS) was adopted. Accordingly, the period 1990-2004 was the designed time-frame for the innovations/inventions that had potential to reflect benefits and/or influence of the Agreement. The study was restricted to innovations that were reported and/or supported by available documentation as a way of ensuring reliability of the data. The study was also restricted to aggregated appropriation-in-aid regarding returns from the specific innovations.

1.8.5. RESEARCH PROBLEMS AND CHALLENGES

Some of the challenges encountered in carrying out this study include the lack of a centralized, categorized and updated data base of innovations and protection, and failure to access certain information especially on the returns from the specific innovations as most of the data obtained captures the financial aggregates from an institution's undertakings and therefore not classified as per innovation. The cost of carrying out this

research and related activities was also very high and at times made it almost impossible for the researcher to cover all areas as expected. This is because it required making regular visits to the sampled institutions, photocopying and printing the obtained information as well as spending much of the time in surfing the net in order to enrich the study. A notable concern was the lack of time due to a busy work schedule and family obligations. However, despite these limitations, timely data and information were obtained and have been used in this study, which is believed, will be useful in enriching policy and academic information gaps.

2 CHAPTER TWO

HISTORICAL DEVELOPMENTS OF INTELLECTUAL PROPERTY RIGHTS

This section of the thesis examines historical developments of IPRs over the last five centuries and justifications that have been made on their applications. It also presents Kenya's adoption of the IPRs and most especially compliance with the TRIPS Agreement.

2.1 GENERAL BACKGROUND ON INTELLECTUAL PROPERTY RIGHTS

Intellectual Property can be defined as information with a commercial value.[88] They are property rights in something intangible and protect innovations and reward innovative activity.[89] It refers to intellect of human mind; the creativity, the thoughts, the ideas in the intangible form, which can be converted to tangible products and protected as private rights.[90] They are thus concerned with the expression of an idea for an invention, the details of which have been worked out and which takes the form of a product or a process that can be applied industrially,[91] and give the creator an exclusive right over the use of his / her creation for a certain period of time. "IP is divided into two categories: Industrial property, which includes inventions (patents), trademarks, industrial designs, and geographic indications of source; and Copyright, which includes literary and artistic works such as novels, poems and plays, films, musical works, artistic works such as drawings, paintings, photographs and sculptures, and architectural designs. Rights related to copyright include those of performing artists in their performances, producers of phonograms in their recordings, and those of broadcasters in their radio and television

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[88] National Consumer Council, 1991

[89] US Council for International Business. (1985). A new MTN: Priorities for Intellectual Property. p3

[90] KIPO, National Council for Science and Technology, NCST, (2002), Development of Institutional Intellectual Property Rights Management System: A Regional workshop under the Bio- EARN Programme on Biotechnology and Intellectual Property Rights held at the Maasai Mara Serena hotel, 6th – 7th December 2001, NCST Publication No. 44, Nairobi. p3

[91] Kameri-Mbote, Patricia. (2005). Intellectual Property Protection in Africa: An Assessment of the Status of Laws, Research and Property Rights in Kenya, International Environmental Law Research Centre Working Paper, Geneva, Switzerland. p1

programs."[92] Very broadly therefore, IP means the legal rights that result from intellectual activity in the industrial, scientific, literary and artistic fields.

The concept of IP incorporates two elements, first; the ideas, inventions, and creations that result from private activity and second; the property status bestowed on those expressions and ideas by the public. Thus throughout its history, the premise underlying IP has been that the recognition and rewards associated with ownership of inventions and creative works stimulate further inventive and creative activity that, in turn, stimulates economic growth.

The main legal instrument for protecting IPRs include patents for inventions; utility models for innovations; industrial designs for aesthetic designs; trademarks for goods; service marks for services; geographical indications which refer to source of origin of goods and services; lay out of integrated circuits; plant breeders rights for plant varieties; undisclosed information for trade secrets, and; copyright and related rights (neighboring rights) which cover literary works, artistic works, musical works, computer programs, and compilation of data. [93]

Countries have laws to protect IP for two main reasons. One is to give statutory expression to the moral and economic rights of creators in their creations. The second is to promote as a deliberate act of government policy, creativity and dissemination and application of its results and to encourage fair-trading which would contribute to economic and social development.[94] IP law therefore aims at safeguarding creators and other producers of intellectual goods and services by granting them certain time-limited rights to control the use made of those productions.

[92] http://www.wipo.int/about-ip/en/
[93] Ibid
[94] World Intellectual Property Office, (1998), *Intellectual Property Reading Material*, WIPO, Geneva. p3

The notion of a property right residing in an individual's writing, creations, or inventions has been in existence for a considerable period of time. According to Smith,[95] as patronage became less available for artisans, the cost of developing innovations increased, inventors and authors needed incentives to expend their time, energy, and capital required to keep the progress of science and the arts moving forward, and that these incentives were most often provided in the form of protection for the intangible property rights in which such advances were embodied.

Kameri-Mbote (2005) observes that: allocating IPRs to the creator of a work balances the private interests of the creator, by ensuring that s/he still has an incentive to create against those of the society at large in having the information available for its use. Even though it does not diminish once it is shared, the role of IPRs is to ensure that information providers do not lose rights to the information by disclosing it, since such information can be used by an infinite number of persons simultaneously. Indeed, one of the philosophic underpinnings of IPRs is to ensure disclosure of the information, the assumption being that lack of such right would discourage information holders from sharing their information for the fear of loosing it. The fear of losing exclusive rights to the information once shared is real because another person can use the same idea without having recourse to the originator of the idea.[96]

The concept of rewarding innovators or creators for their ideas can be traced back to the debate between Aristotle and Hippodamus of Miletus in the fourth century B.C, there is also some evidence of the recognition of the concept of authorship, for example, from as early as 400 BC and hard evidence in Pliny the Elder's encyclopedia of the first century A.D. By that time, individuals in various civilizations recognized the importance of protecting human thought, or intellectual property, as distinct from divine inspiration. Systematic protection of intellectual property by governments, however, is usually traced back to Renaissance Italy. Skilled craftsmen were making world famous glass products in Venice as far back as the eleventh century. Recognizing the importance of the industry,

[95] Smith, M. W. (1999), "Bringing Developing Countries' Intellectual Property Laws to TRIPS Standards: Hurdles and Pitfalls facing Vietnam's efforts to normalize an Intellectual Property Regime", in *Western Reserve Journal of International Law*, Vol. 31, issue. 1.
[96] Kameri-Mbote, 2005:1

the government encouraged the export of the products, but banned the export of the craft. As in earlier times, the secrets of making better glass were protected by guilds.[97]

The earliest known patent on an invention was awarded in Florence in 1421 to Filippo Brunelleschi for a barge with hoisting gear capable of transporting marble. In Britain the first such patent was awarded in 1449 to a Flemish glassmaker for a method of making stained glass windows. During the 16th century, the English monarchs discovered that the sale of monopoly privilege could be very lucrative and granted patents on an indefinite basis to all manners of trades and manufactures, regardless of their novelty.[98]

A Venetian Law of 1474 made the first systematic attempt to protect inventions by a form of patent, which granted an exclusive right to an individual for the first time. In the same century, the invention of the printing press by Johannes Gutenberg around 1450 contributed to the birth of the first copyright system in the world. Towards the end of the 18th century, inventions on manufacturing had fundamental influence on large-scale industrialization accompanied by such phenomena as rapid city growth, expanding railway networks, the investment of capital, and growing transoceanic trade. Industrialism, the emergence of stronger centralized governments, and stronger nationalism led many countries to establish their first modern IP laws.[99] The table below provides a summary of the instruments and subject matter of IPRs as summarized by Carlos Primo-Braga.[100]

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[97] Primo-Braga, Fink, and Sepulveda, 1998
[98] Morris, J et al., 2002
[99] WIPO: 2003
[100] Carlos Primo-Braga in "Trade–Related Aspects of Intellectual Property Rights. The Uruguay Round Agreement and its economic implications" (World Bank Conference Paper, 26-27 January 1995), adapted by the author from United Nations 1993, Table 2; (WIPO 1994)

Table 2: Intellectual Property Rights

Types of Intellectual Property Rights		Subject matter	Main field of application	Major international agreements
Types of instruments				
Industrial property	Patents	New, non-obvious, industrially applicable inventions.	Manufacturing	Paris convention; Patent Cooperation Treaty; Budapest Treaty
	Utility models	Functional designs	Manufacturing	Paris convention
	Industrial designs	Ornamental designs	Clothing, motor cars, electronics, etc.	Hague Agreement, Paris Convention , Locarno Agreement
	Trade marks	Signs or symbols to distinguish the goods and services of one enterprise from those of others	All industries	Paris convention; Madrid Agreement (International registration); Nice Agreement; Madrid protocol; Trademark Law Treaty
	Geographical indications	Identification of the place of origin of goods indicative of the quality or other characteristics associated with the area	Agricultural and food industries notably the sellers of wine and spirits	Lisbon agreement; Madrid Agreement (false indications)
Literary and artistic property	Copyright and neighboring rights	Original works of authorship and related contributions from performers, producers of sound recordings and broadcasting organizations	Printing, entertainment (audio, video, motion pictures) software, broadcasting	Berne Convention; Rome Convention; Geneva Convention; Brussels Convention; universal copyright Convention
***Sui generis* Protection**	Breeders' rights	New, stable, homogenous distinctive varieties	Agriculture and food industry	Union for the Protection for New Varieties of Plants (UPOV)
	Integrated circuits	Original layout designs	Macro-electronics industry	Washington Treaty
Trade secrets		Secret business information	All industries	

Source: Carlos A. Primo Braga, in, Martin, W. Winters, A. (Eds).(1996), The Uruguay Round and the Developing Countries, Cambridge University Press.

In a comprehensive survey of economic theories of the field of IP, Menell, P.S. (1999) distinguishes two paradigms that explained the award of IP: utilitarian and non-utilitarian theories. Utilitarian theories have as their objective the maximization of economic wealth

through innovation and invention in the long run, or, in the short run, the achievement of economic efficiency. These theories are applied to patents, copyrights, trademarks and trade secrets.[101] Towse and Holzhauer (2002) have indicated that the utilitarian approach is embodied in what is called "Anglo-Saxon law" which is the underlying jurisprudence of the USA, the UK and those countries that inherited English law, for example, Australia, New Zealand, most of Canada, India and countries in Africa.[102]

The utilitarian theories assume that the objective of any policy should be the attainment of the greatest good for the greatest number. The utilitarian philosopher Jeremy Bentham [1748-1832], who wrote in the 18th century introduced ethical principles or morals into property right theory and laid the responsibilities in the hand of the state to identify and enforce such. In this context, it is not only society's duty to protect the inventor, but also to secure the inventor a fair share of the reward when exploiting the inventor's knowledge and ideas. The idea is that it would be immoral if the law permits everybody free use of the work of an inventor without his or her consent and without compensation or equivalent in return. The rationale is basically that justice requires society compensate and reward its people for their services in proportion to what they cost and how useful they are to society. In this respect Bentham and his contemporaries considers the most appropriate way to secure inventors is by issuing IPRs.[103]

The utilitarian formulation by John Stuart Mill (1873) holds that a law is justified when it promotes the "general happiness." Mill's understanding of happiness is simply "pleasure and freedom from pain"[104] and this "general happiness" is "understood as the sum or perhaps average of the enlightened self-interests."[105] A good or just law for Mill's utilitarianism is thus one where its enforcement brings about more pleasure than would exist without it. In this premise the pleasure and pain considered is not simply physical, but intellectual as well.

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[101] Menell, P.S. (ed) (1999), "1600, Intellectual Property: General Theories", Encyclopedia of Law and Economics, Boudewijn Bouckaert and Gerrit De Geest: http://encyclo.findlaw.com/index.html

[102] Ibid

[103] See Donner, W. (1998), "Mill's Utilitarianism", in Skoropski, J., (Ed), *The Cambridge Companion to Mill*, Cambridge University Press, Cambridge.

[104] Ibid: 257

[105] Riley, J. (1998), "Mill's Political Economy: Ricardian Science and Liberal Utilitarian Art", in the Cambridge Companion to Mill, Ed John Skonipski, Cambridge University Press, Cambridge. p294

The arguments purporting that intellectual works abstracted from matter can be held as property derive in large part from modern philosophers who deal with property, such as Locke and Hegel. Locke bases his defense of property in man's labor and his "ownership" of his own labor. According to Locke (1967),

> *"Though the earth and all inferior creatures be common to all men, yet every man has a property in his own person; this nobody has any right to but himself. The labor of his body and the work of his hands we may say are properly his. Whatsoever, then, he removes out of the state that nature hath provided and left it in, he hath mixed his labor with, and joined to it something that is his own and thereby makes it his property. It being by him removed from the common state nature placed it in, it hath by this labor something annexed to it that excludes the common right of other men."*[106]

Hegel bases his defense of property in man's personality and his "right" to develop this personality in the physical world. On this view, any creative work is an act of self-expression or self-realization, and is thus an extension of the creator's person. As such it belongs to the creator, not just as an object, but as part of the person's self.

Locke's labor theory and Hegel's personhood theory of property together make up the core of natural rights arguments defending copyrights and patents as they extend property rights to intellectual works. They provide the foundation upon which other modern theories are built.[107]

2.1.1 WORLD INTELLECTUAL PROPERTY ORGANIZATION (WIPO)

Prior to the TRIPS Agreement the rules governing the protection of intellectual property at the multilateral level were established primarily through the World Intellectual Property Organization (WIPO) Conventions. The WIPO Conventions did not attempt to establish exclusive standards for the protection of IPRs, although they limited state discretion in a number of ways (for example, by requiring national treatment). In principle, state parties to the WIPO Conventions remained free to adopt more extensive

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[106] Locke, J. (1967), *Two Treatises of Government*, 2nd Ed, Cambridge University Press, New York. p305-6

[107] Weber, D. (2002), *A Critique of Intellectual Property Rights*, Christendom College, Front Royal, Virginia.

protections than those specifically mandated by the agreements. While the Berne Convention established minimum standards of copyright protection, the Paris Convention did not define the principal substantive standards of patent protection, essentially leaving this to each state party.[108]

WIPO is one of the specialized agencies of the United Nations (UN) system of organizations.[109] The convention establishing World Intellectual Property Organization was signed at Stockholm in 1967 and entered into force in 1970. However, the origins of WIPO go back to 1883 and 1886, with the adoption of the Paris and Berne Conventions, which provided for the establishment of international secretariats. The most recent name of the organization, before it became WIPO, was BIRPI, the acronym of the French language version of the name: United International Bureau for the protection of Intellectual Property.

The agreement between the UN and WIPO recognizes that WIPO is, subject to the competence of the UN and its organs, responsible for taking appropriate action in accordance with its basic instrument, treaties and agreements administered by it, inter alia, for promoting creative intellectual activity and for facilitating the transfer of technology related to industrial property to the developing countries in order to accelerate economic, social and cultural development.[110]

The activities of WIPO are basically of three kinds; registration activities, the promotion of intergovernmental co-operation in the administration of intellectual property, and substantive or programme activities.[111] These activities serve to maintain and increase respect for IP throughout the world, in order to favor industrial and cultural development by stimulating creative activity and facilitating the transfer of technology and the dissemination of literary and artistic works.

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[108] UNCTAD, 2002:11
[109] WIPO, 1998: 4
[110] Ibid, p5
[111] Ibid, p7

The registration activities of WIPO involve direct services to applicants for, or ownership of industrial property rights. They concern receiving and processing international applications under the Patent Co-operations Treaty or for the international registration of marks or deposits of industrial designs. Intergovernmental co-operation are concerned with the management of collections of patent documents used for search and reference, and devising means for making access to the information which they contain easier. The substantive or programme activities include promoting the wider acceptance of existing treaties, updating where necessary such treaties through their revision, concluding new treaties and organizing and participating in development co-operation activities.[112]

2.1.2 INTELLECTUAL PROPERTY PROTECTION REGIMES

Multilateral negotiations on IP issues have resulted in a large number of WIPO administered agreements that for many years have laid down rules to govern different aspects of protection of IP. Among these agreements include; the Paris convention of 1883 on the protection of industrial property, particularly through patents and trademarks. It covers property rights for patent, utility models, service marks, and trademarks. Article 1 of the convention states in paragraph 3 that, industrial property shall be understood in the broadest sense and shall apply not only to industry and commerce proper, but likewise to agricultural and extractive industries and to all manufactured or natural products. It further allows member countries to protect innovations of indigenous and local peoples as indicated in Article 7, member countries therefore should accept for filling and to protect collective marks belonging to associations the existence of which is not contrary to the law of the country of origin, even if such associations do not own industrial or commercial establishment.[113]

The Berne Convention of 1886 on the protection of literary and artistic works provides the main international rules on copyright, "with other rules incorporated in the universal

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[112] International Bureau of WIPO, WIPO/ACAD/E/94/2.
[113] Kenya Industrial Property Organisation, (2001), *Kenya Industrial Property News*, The Inventor, Issue No. 008, KIPO, Nairobi. p73.

copyright convention (administered by UNESCO) and the Rome convention (which concerns protection of performers, broadcasters and producers of sound recordings).[114]

Other IP regimes include the Madrid Agreement and Protocol for international trademarks application; the Budapest treaty for the international classification of patents; the Patent Cooperation Treaty for the international registration of patents; the European Patent Convention; The Hague Agreement for industrial designs; The Agreement on trade related aspects of intellectual property rights (TRIPS) in 1994. The agreement requires member states to "provide patent protection for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve any inventive steep and are capable of industrial application."[115]

Another regime is the Convention on Biological Diversity (CBD) of 1992. It recognizes the importance of traditional knowledge and the rights of indigenous and local communities in that knowledge. In its preamble the CBD recognizes " the close and traditional dependence of many indigenous and local communities embodying traditional lifestyles on biological resources, and the desirability of sharing equitably benefits arising from the use of traditional knowledge, innovations and practices relevant for the conservation of biological diversity and the sustainable use of its components."[116]

The International Convention for the Protection of New Plant Varieties (UPOV) of 1991 is the only international treaty focusing on plant variety protection with the specific aim of introducing private property rights on plant varieties. Its 1978 version allows farmers to re-use propagating material from the previous seasons harvest and to freely exchange seeds of protected varieties with farmers. Another instrument is the International Undertaking on Plant Genetic Resource of 1993 that was adopted as a non-binding instrument. The instrument covers both traditional cultivars and world species, and

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[114] Croome, J. (1999), Reshaping the World Trading System: A history of the Uruguay Round, Kluwer Law International, Boston. p109

[115] http://www.wto.org/english/docs_e/legal_e/27-TRIPS_03_e.htm

[116] KIPO, 2001: 73.

varieties developed by the scientists in laboratories. It further gives countries sovereign rights over their plant genetic resources.

2.1.3 INTERNATIONAL SYSTEMS

International systems of IPRs exist, and are administered by WIPO. In the area of Patents, the Patent Cooperation Treaty (PCT), provide a system under which applicants may file one international application, which is valid in all contracting states designated by the applicants. Certain of the ensuing stages of the processing of the application take place on the international level, while the final stages are reserved for the national (or regional) patent office. The stages that take place at the international level are the publication of the application, an international search of the application and, at the option of the applicant, an international preliminary examination of the application. There are eight nine (89) states party to the PCT.

In the area of Trademarks, the Madrid Agreement concerning the international registration of marks provides an International system under which a single application can result in a single international registration in all of the designated contracting states. Forty –Six (46) countries are party to the agreement. In the area of Industrial Designs, an international system is administered by WIPO under the Hague Agreement concerning the international deposit of industrial designs. The Hague Agreement regrettably enjoys a limited geographical participation, only twenty-six (26) states being party to it.[117] Despite WIPO's efforts to promote international conformity toward IPR protection, it is noted that countries had achieved little comity by the mid – 1980s.[118]

2.1.4 REGIONAL SYSTEMS OF IPRS

IPRs are territorial, which implies that they are basically national in nature since national laws create them. This means that IPR applications are different, thus creating a problem of uniformity "users seeking protection across different markets are obliged to file

[117] See Gurry, F. (1997) "the Evolution of Technology and Markets and the Management, of IPRS" in Abott and Gerber, (1997). P*ublic Policy and Global Technological Integration.* p 29-30
[118] Primo-Braga, 1996:342

separate national applications, often requiring different administrative formalities and legal conditions to be satisfied in each country in which they seek protection."[119] Attempts to address this problem has resulted in the creation of regional systems which address the administrative aspects of IPRs, they provide either for the processing and grant on the regional level of separate national titles in the participating member states of the regional system.

Gurry, F. (1997) has outlined the various regional systems that govern the different areas of IPRs ranging from patents to industrial designs. These are as follows; the regional patent and industrial design system administered by the European Patent Organization (EPO) for the processing and grant of regional titles. The regional system for patents, trademarks and industrial designs administration by the African Intellectual property organization (OAPI); the regional patent system administered by the Eurasian Patent Organization, and the regional trademarks systems administered by the office of Harmonization for the Internal Market (OHIM) of the European Union.[120]

2.2 TRIPS NEGOTIATIONS

The TRIPS Agreement negotiated during the Uruguay Round sets minimum standards of IP. The introduction of IPRs as one of the 'new issues' in the Uruguay Round was approved at the Ministerial meeting held in Punta del Este in 1986, but limited in principle to the issue of trade in counterfeit goods, that is, goods infringing trademarks or copyrights. The industrialized countries' proposals concerning matters for negotiation were later extended to standards on practically all aspects of IPRs.

The lax rules on infringement of IP meant an increase in trade of counterfeit and pirated goods, which could adversely affect the development of international trade. This was witnessed in the years before the Uruguay Round, largely due to unsatisfactory enforcement of trademark and copyright laws in many countries. Furthermore, patented

[119] Gurry, F. 1997: 28
[120] Ibid, p28-30

technology was being used by manufacturers without licensing from patented owners.[121] Proposals to take action in GATT to control the trade in counterfeit and pirated goods were made by the developed countries as early the Tokyo Round of negotiations (1973-1979).[122] It was in the Uruguay Round however, that IPRs became a major topic for negotiation.

Beginning in the 1980s, the value of unrealized sales lost to piracy provided enough data to inspire developed countries to seek more stringent protection abroad, for instance in 1994, the US suffered over $11.66 billion in lost potential income to piracy outside the US. Other estimates claimed losses of up to $40 billion a year due to unauthorized copying. These increasing losses to piracy combined with a widening trade deficit and a perceived faltering of the United States 'world-wide economic dominance' made the U.S. more responsive to the complaints of its companies. Uphoff (1991) stated that "the sudden emergence of IP protection as a major goal of US foreign economic policy in the 1980s was a result both of an objective change in the value of IP, and of the domestic political debate over trade deficit and the relative decline of American economic power."[123]

Companies saw that the US government and governments of other developed countries could make access to their markets conditional upon implementing stronger levels of protection. The US government initially demanded that countries where piracy was occurring enforce IP protection or face trade sanctions, later the government sought higher levels of protection thorough multinational accords due to the view that, "under WIPO, developing countries exerted enough power as a group to create a stalemate with developed countries over revision of the Paris Convention. However, the GATT provided a much more effective means for developed countries to exert pressure on other countries to modify their IP systems. Developed countries could use trade and access to their markets to encourage adoption of stronger IP enforcement. This shift from WIPO to

[121] International Trade Centre, (1999), *Business Guide to the World Trading System*, 2nd edn, Geneva. p13
[122] ITC, 1999:239
[123] Uphoff, E., (1991), Intellectual Property and U.S. Relations with Indonesia, Malaysia, Singapore, and, Thailand

GATT and the use of trade as a means for encouraging stiffer IP protection gave worldwide IP protection a fundamental trade aspect. TRIPS then emerged as a prerequisite to membership in the newly organized WTO."[124]

The proposal for minimum standards of protection raised debates among and between developing and developed countries giving IPR issues a North-South dimension, making the negotiations controversial in nature before and after launching the Uruguay Round. The arguments stemmed from the knowledge that know-how and brand names belong overwhelmingly to the richest and most developed countries, and in particular large corporations that arouse strong and often hostile emotions in developing countries.[125]

The developed countries saw IP as "the fruit of the creative capacity and intellectual effort of the individual citizens and companies"[126] and viewed it as the legitimate basis for these individuals and companies to earn trading advantage. They argued that in the absence of such protection, and the promise of later reward, research and development that led to inventions and new products of value to all would simply not take place.[127] The developed countries equated protection of technology with protection of their market power, thus their dissatisfaction with implementation of the IPRs through WIPO which did not have an effective enforcement system.

The developing countries were apprehensive that the negotiations would require them to change their policies. The apprehensions of developing counties has to do with their ability to pursue public policy that ensures access to health care to their people at affordable prices and the development of agriculture[128] which was the basis for denying product patents for food, pharmaceuticals and chemicals. The developing countries were disputing the minimum standards from the perspective that their citizens and companies had little IP of their own to protect, and thus did not see the reason to give support that

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[124] Smith, M. 1999
[125] Croome, J. (1999), Reshaping the World Trading System: A history of the Uruguay Round, Kluwer Law International, Boston. p100
[126] Ibid, p110
[127] Croome, J. 1999: 110
[128] Zutshi, B.K. (1998), "Bringing TRIPS into the Multilateral Trading System", in Bagwati, J. Hirsch, M., (eds) (1998), *The Uruguay Round and Beyond*, Springer – Verlag, Berlin. p41

would require them to pay increased royalty payments for the use of patented technology under license, leading to higher prices for the products manufactured, as well as the fact that these standards might deny them access to the technology they needed, especially in pharmaceuticals and high – technology products which were necessary for health provision and development.

Until 1989, developing countries refused to enter into detailed negotiations on standards, but the threat of unilateral retaliatory trade sanctions played a role in changing the stand of many developing countries on the matter. China, Brazil, India, Taiwan and Thailand, for example, were "investigated" under the 'Special 301' section of the US Trade Act.[129] The developed countries argued that IPRs were frequently given inadequate protection and that these rights tended to be ineffectively enforced. The US gave notice that it would be putting forward proposals to improve both protection and enforcement.[130] The developing countries on the other hand were concerned about the distortion of trade that might be caused by increased protection of IP and also in general did not want to discuss issues that were outside trade matters.

The negotiating capacity of developing countries was not only weak due to their vulnerable economic position, but also because of the considerable difference in the specialist knowledge available to them in the conduct of extremely complex discussions. While developed countries were able to mobilize teams composed of top specialists in the various areas dealt with, developing countries lacked the necessary technical support.

In practice, the actual drafting process was confined to a very few countries. The main discussions took place in a so-called 'five plus five' drafting group composed of five developed and five developing countries (Developing countries that participated in this drafting group in general included Brazil, Argentina and India; representatives of other Latin American or Asian countries were called upon according to the issue at stake. Developed countries included, as a rule, the European Community, USA, Japan and

[129] South Centre, (1997), "The TRIPs Agreement: A Guide for the South: The Uruguay Round Agreement on Trade-Related Intellectual Property Rights", South Centre, Geneva.
[130] Croome, J. 1999: 111

Canada). The agreements reached in this group were later on referred to a broadened 'ten plus ten' group convened in accordance with the presiding officer's directions. With the exception of the members of these groups, the remaining countries had little real opportunity to influence the outcome of the drafting groups' work. Moreover, during the negotiations the co-ordination of developing countries' positions was, in general, weak, though some regional groups like that of Latin America were on the whole able to articulate their negotiating position.[131]

By late 1987, the group discussing TRIPS were facing a broad sets of problems. The enforcement of IPRs; the rights themselves; the use of those rights by others other than their holders; dispute settlement; the existing GATT rules; and whether negotiations on these problems could be undertaken within the Uruguay Round.[132] The controversial issues included the question of whether the TRIPS should be discussed in the Uruguay Round well aware that WIPO and other specialized organizations dealing with IPR issues were the proper place to discuss issues of substance on IPR.

Another very crucial issue was the area of patents. The concern of developing countries related to the general category, as well as specific sectors for example, pharmaceutical, agricultural and general food products. Developed countries were arguing for limited exclusions on grounds of public morality and for security considerations while developing countries were seeking exclusion also on grounds of public policy. A further patent issue was lack of protection for advanced technologies such as integrated circuits and biotechnology.[133] The basic US rule on the application of patents was also another problem; the rule gave priority in recognizing patent eligibility according to the date of the invention when it was made in the US, but which still based the priority of applications for foreign inventions only on the date when application was filed. This rule is different from that which is applied in other countries.

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[131] South Centre, 1997
[132] Croome, J. 1999:111
[133] Ibid, p112

Other issues included the question of adequate standards and principles of IP, rights available, coverage and exercise of IP. In October 1987, the US proposed that the group should negotiate a comprehensive GATT agreement on IP matters that would cover minimum standards for protection and enforcement in national law of; patents, trademarks, copyright, trade secrets and the layout design of semiconductors.

In May 1990, a group of 14 developing countries comprising Argentina, Brussels, Chile, Columbia, Cuba, Egypt, India, Nigeria, Peru, Tanzania, and Uruguay submitted a draft IP agreement.[134] These countries had been part of those developing countries that had been most reluctant to negotiate stronger protection of IP in GATT. The draft was in two parts, part I laid down the objectives, principles and norms, and border measures related to counterfeit or piracy, these were all in relation to IP and international trade, while part II was in regard to patents. It laid down the objectives and principles in respect to norms and scope, and obligations of the patent holder, use of the patents for government purposes and a license of the rights.

Switzerland, the US, and the European Economic Community (EEC) also put up draft agreements. The Swiss draft had TRIPS as an integral part of GATT while the US and the EEC draft wanted TRIPS to be a separate agreement from the GATT system; these three agreements were incorporated in July 1990 in a draft text by the Chairman of the negotiating group. The draft text became the basis for negotiations until the Brussels meeting in December 1990. It is noted that the Brussels meeting went well but never reached the point of trying to resolve the most critical issues, which required tough decisions at the highest level that were never going to be forthcoming except in the context of general break through[135] these issues concerned patenting of agricultural goods as well as pharmaceuticals and textiles, and there was no agreement especially by the developing countries on the transition periods.

[134] Zutshi, B. 1998:44
[135] Croome, J. 1999:244

Between 1991 and 1992, most developing countries had, under bilateral pressure, substantially changed their negotiating position in regard to most of the contentious issues in the TRIPS Agreement, which was particularly true of patents.[136] The US had resorted to the use of unilateral measures under their super 301 and special 301-trade legislation to try to open the markets of developing countries. Special 301 was used as an instrument against developing countries on IPRs, on a bilateral basis.[137] On 18 December 1991, the TRIPS group held its last meeting with a draft that was almost fully negotiated.

The results of the negotiations were contained in the Dunkel Draft tabled on the group's last meeting, and the text that was finally adopted in Marrakesh in April 1994 was virtually the same as the Dunkel Draft. It contained only two relatively small changes of substances; the addition of certain text relating to semi-conductor technology in Article 31(c), the other was the text that ruled out non-violation-complaints for at least five years.[138] The TRIPS Agreement formulated and adopted consists of seven parts, as summarized in the table below.

Table 3: Structure of the Agreement on Trade Related Aspects of Intellectual Property Rights

Part I General provisions and Basic principles.
PART II Standards concerning the availability, scope and use of IPRs
1. **Copyright and related rights**
2. **Trademarks**
3. **Geographical indications**
4. **Industrial designs**
5. **Patents**
6. **Layout designs (topographies) of integrated circuits**
7. **Protection of undisclosed information**
8. **Control of anti- competitive practices in contractual licenses**

PART III Enforcement of Intellectual Property Rights
1. **General obligations**
2. **Civil and administrative procedures and remedies**
3. **Provisional measures**
3. **Special requirements related to border measures**
4. **Criminal procedures**

PART IV Acquisition and maintaining IPRs and related *inter partes* procedures
PART V Dispute prevention and settlement
PART VI Transitional Arrangements
PART VIII Institutional Arrangement: Final provisions

Source: Carlos A. Primo Braga, in, Martin, W. Winters, A. (Eds). (1996). The Uruguay Round and the Developing Countries, Cambridge University Press.

[136] Zutchi, B. 1998: 44
[137] Ibid, p45
[138] Ibid, p47

2.3 INTELLECTUAL PROPERTY SYSTEM IN KENYA

As has been observed, IP has increasingly become a strong feature of international and regional trade arrangements, and national legal instruments. From multilateral to regional and bilateral trade relations, IP issues almost inevitably come to the fore as a critical issue to be considered in any deals struck[139] and Kenya has not been spared albeit the controversies that surround the benefits or adverse effects of these IPR undertakings.

Kenya sought to strengthen its IP regimes through enacting and adopting IP related legislations and treaties. Noteworthy though, intellectual property laws in Kenya like most other laws are a colonial heritage. Prior to the enactment and coming into force of the Industrial Property Act, Cap 509 of 1990, Kenya had a patent system that was wholly depended on the British patent system. Under that arrangement, a patent granted in the United Kingdom (UK) was valid for registration in Kenya. This system did not create a favorable environment for Kenyan innovators who had to file an application in UK and if granted patent, have it registered in Kenya. Data collected from Kenya Industrial Property Institute (KIPI) provides that about 97% of the patents granted in Kenya under this system were held by the developed world.[140]

Kenya enacted the Industrial Property Act, Cap 509, in December 1989, after the repeal of the Patent Registration Act Cap 508. It came into force in February 1990. Although the new Industrial Property Act, (No.3) of 2001 was enacted by the Kenyan parliament in August 2001 in compliance with TRIPS Agreement; the 1990 Act is still in force. It is important to note that some provisions of the Act intended to facilitate access to essential drugs especially for HIV/AIDS. Section 58 of the Act for instance, allows for parallel importation by limiting patent rights in respect of articles put on the market in Kenya or any other country or imported into Kenya.

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[139] Kameri-Mbote, 2005:1

[140] Mwalimu, A. (2002), "Implications of WTO/TRIPS in East Africa with special emphasis on Pharmaceutical Patents", presented at a workshop on "Globalization and East Africa 15-16th April, 2002", Economic and Social Research Foundation, Dar es Salaam. p7

Kenya is actively involved in the formulation and implementation of international policy on IP. She signed the final act of the Uruguay Round and the Marrakesh Agreement establishing the WTO on 15th April 1994, and accession to the WTO was ratified on 23 December 1994, and Kenya became a member of WTO on 1 January 1995. Under the single undertaking, all WTO multilateral Agreements became binding on Kenya.[141]

Kenya is party to the main regional/international treaties/agreements on IP including the following; Paris Convention for the Protection of Industrial Property (1883), Nairobi Treaty on the Protection of the Olympic Symbol (1981), Trademark Law Treaty (TLT) (1994), Madrid Agreement concerning the International Registration of Marks (1891), since 26th June 1998, Protocol Relating to the Madrid Agreement concerning the International Registration of Marks (1989) since 26th June 1998, Patent Cooperation Treaty (PCT) of 1970 since 1994, Lusaka Agreement establishing ARIPO of 1976, Harare Protocol for the Protection of Patents and Industrial Designs of 1982, Banjul Protocol for the Registration of Marks, WIPO Treaty establishing WIPO of 1970, International Union for the protocol of New Plant Varieties (UPOV), and the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) of 1995.

2.3.1 KENYA'S LEGISLATION ON INTELLECTUAL PROPERTY

There are four main legislative instruments in operation in Kenya with respect to IPRs, these are: The Industrial Property Act Cap 509; the Trademark Act Cap 509; the Seed and Plant Varieties Act Cap 326 and, the Copyright Act Capt 150, Laws of Kenya. Other IP laws include; Design law, and the unfair competition prevention law. Legislations on protection of geographical indications and lay out of integrated circuits are being processed for enactment. The Industrial Property is protected under the Kenya Industrial Property Institute, Copyrights and related rights Act is administered by the department of the Registrar General, office of the Attorney General and, the Seed and Plant Varieties Act is administered by Kenya Plant Health Inspectorate Services (KEPHIS).

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[141] WTO, (2000), *Trade Policy Review: Kenya 2000*, WTO, Geneva. p17

2.3.2 KENYA INDUSTRIAL PROPERTY INSTITUTE (KIPI)

The Kenya Industrial Property Institute (KIPI) is a body corporate under the Ministry of Trade and Industry, charged with protection of intellectual properties. Previously it was called the Kenya Industrial Property Office (KIPO). It was established in 1990 by an Act of parliament, under the Industrial property Act Cap 509 (1989). It therefore is the government's agency that administers industrial property rights.

The main function of KIPI is to provide for the promotion of inventive and innovative activities and to facilitate the acquisition of technology through the grant and regulation of patents, utility models, rationalization models and industrial designs and other related purposes.

KIPI has three main divisions, namely; legal services and trademarks; technical services and patents and; personnel and administration. Its core functions are to: receive and consider applications for grant of industrial property rights; screen technology transfer agreements and licenses; provide industrial property information, and, promote inventiveness in Kenya.[142] Among other activities, KIPO undertakes administration of industrial property rights, documentation and information dissemination, provision of general information about IPRs to the general public through an outreach program, and facilitates technology transfer through provision of technological information available in patent documents.[143]

KIPI has about 12 million patent documents representing roughly 30% of the global patent documents; most of the patent documents come from European Patent Office, United States Patents Trademarks office, and Japanese Patent Office. It has received several patent applications from various countries directly and through Patent Cooperation Treaty. This has placed KIPI in a position to disseminate patent information and documentation and to evaluate and advice on technology transfer and licensing agreements.

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[142] KIPO, NCST, 2002: 3.
[143] Ibid

3 CHAPTER THREE

THE CASE STUDIES

Introduction

This chapter looks at protection of intellectual property generated by selected public research institutions in Kenya. Kenya Agriculture Research Institute (KARI), Kenya Medical Research Institute (KEMRI) and Kenya Industrial Research and Development Institute (KIRDI) were chosen as case studies to; examine the capacities of the public research institutions in Kenya to claim and exploit the benefits of IPR that accrues from their R&D activities; the extent to which they rely on external funding such as donors and collaborators, and if this has had any effect on their ability to effectively claim IPR and accruing benefits from the inventions and innovations; determine the innovations that are protected have higher returns and greater social and economic gains and finally; examine the implication of domestication of TRIPS by the Kenyan government to the institutions and how they have responded to the changes.

In each case study, we look at the background information of the selected institution, its recorded R&D, institutional capacity, investment by the government in terms of development and recurrent expenditure and income generated by the institutions from their innovations. The study also examines some of the successes achieved by the institutions, the current IP status of each institution and problems experience with regard to the same.

3.1. KENYA AGRICULTURAL RESEARCH INSTITUTE (KARI)

Background

KARI was established in 1979 under the Science and Technology Act, Cap 250 to develop and disseminate appropriate agricultural and veterinary technologies. It contributes to the sustainable improvement and economic enhancement in the livelihoods of Kenyan citizens by increasing agricultural productivity, post harvest value of agricultural and livestock products, and conservation of the environment. Its strategic

objectives include developing and validating appropriate technologies and knowledge, developing or enhancing appropriate participatory and consultative technology development approaches and methodologies, disseminating knowledge and technologies and catalyzing the process of outreach and adoption of agricultural technologies, contributing to and influencing the development/change of agricultural policy environment, strengthening the efficiency, effectiveness and sustainability of its institutional capacity and, establishing sustainable funding initiatives.

Institutional Capacity at KARI

KARI has twenty-two (22) centers and fourteen (14) sub-centers (Appendix 1). These include the KARI headquarters in Nairobi, Alupe, Embu, Garissa, Kakamega, Machakos, Kiboko, Kibos, Kitale, Lanet, Marsabit, Molo, Mariakani, Matuga, Mtwapa, Msabaha, Muguga, Naivasha, Njoro, Mwea, Perkera, Ol Joro Orok, Tigoni, Thika, and Transmara. These centers are assigned mandates and responsibilities according to ecological diversity, importance of factor of production, importance of commodity, and special circumstances in areas necessary for exploring future potentials in specific geographic regions. At the time of this study, the total human resource at KARI stood at 3,536 of which 12.1 % were researchers and/or scientists. Table 4 and Chart 1 below provide a summary of the human resource in KARI.

Table 4: Human Resource at KARI

Category	KARI	%
Research	427	12.1
Technologists	121	3.4
Technicians	226	6.4
Administration & Support	2762	78.1
Total	3536	100

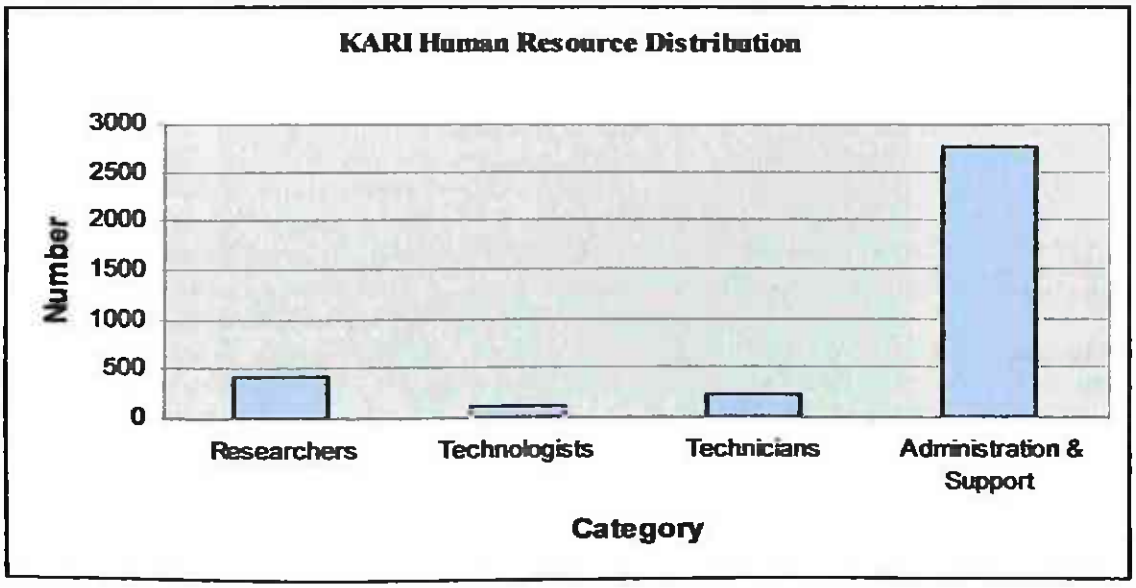

Chart 1: KARI Human Resource Distribution

Investment at KARI

The influence of investment on research and innovations was examined with the amount of budgetary allocation to KARI by the Government and the collaborating agencies. Table 5 below presents the development and recurrent expenditure estimates and earnings from innovations at KARI.

Table 5: Development and Recurrent Expenditure Estimates of KARI

Year	Development Expenditure	Recurrent Expenditure	Earnings from innovations
1990/1	144,612,920	16,823,880	-
1991/2	310,319,520	338,758,380	-
1992/3	263,879,060	344,634,180	561,445,660
1993/4	343,795,600	448,531,560	526,298,040
1994/5	440,350,260	565,232,680	798,686,080
1995/6	327,308,440	591,267,940	472,004,300
1996/7	198,849,500	596,325,700	387,645,000
1997/8	92,461,700	639,645,660	371,022,800
1998/9	199,409,600	738,970,640	565,184,060
1999/2000	316,841,840	696,000,000	521,480,660
2000/1	372,145,413	695,400,000	937,169,020
2001/2	256,459,448	950,609,323	338,777,974
2002/3	149,391,689	820,638,567	390,800,000
2003/4	124, 575, 991	861, 638, 657	-
Total	**3,540,400,981**	**8,304,477,167**	**5,870,513,594**

Source: GoK Development Expenditure Estimates (various years)

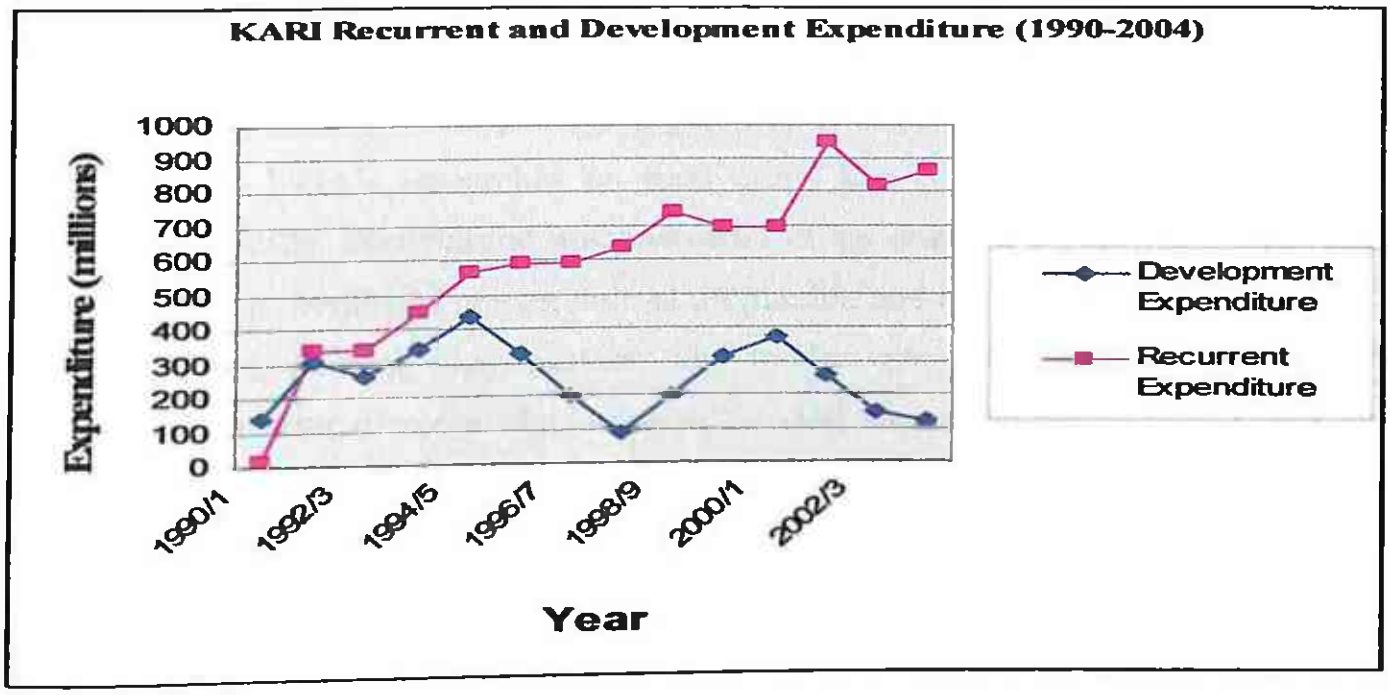

Chart 2: KARI Recurrent and Development Expenditures

Table 5, above shows the expenditures and earnings over the period of the study at KARI, whereby KARI invested approximately 3.5 billion during the period 1990 and 2004. During the same period its recurrent expenditure stood at 8.3 billion shillings, it also earned slightly less than 6 billion shillings from sales of services and goods, some of which with IP implications. The level of development expenditure against recurrent expenditure in the institution stood at 42.6%.

Collaborating Agencies at KARI

KARI maintained twenty-one (21) collaborations with international research institutions and multinational corporations as shown in table 6 below. These agencies provided up to 60 % of the research funds, institutional infrastructure and substantial technical assistance through researchers and/or technologists. The study notes that without this support the level of R&D in the institution would be lower. It was observed that some of the IP that accrues from such collaborations are not claimed directly by the Kenyan scientists as it is viewed as public knowledge.

Table 6: KARI International Collaborators

No.	Collaborating Institution
1.	World Bank
2.	ASARECA - Association for Strengthening Agricultural Research in East & Central Africa
3.	DIF - Department for International Development
4.	ILRI - International Livestock Research, Institute
5.	World Agro forestry Centre
6.	IMWIC - International Maize and Wheat Improvement Centre
7.	FARA - Forum for Agricultural Research in Africa
8.	ICIPE - The International Centre of Insect Physiology Ecology
9.	ISAAA - International Service for the acquisition of Agri-Biotech Applications
10.	TSBF - Tropical Soil Biology & Fertility
11.	ABSF - African Biotech Stakeholder Forum
12.	IIPA - International Institute for Tropical Agriculture
13.	CIP - International Potato Research Centre
14.	CIAT - International Centre for Tropical Agriculture
15.	GTZ - German Development Corporation
16.	ICRISAT - International Crop Research Institute For the Semi-Arid Tropic
17.	IIBC - International Institute of Biological Control
18.	IITA - International Institute of Tropical Agriculture
19.	ISNAR - International service for National Agricultural Research
20.	UPOV - International Union for the Protection of New varieties of plants
21.	MONSATO - MONSATO Company

At the local level, KARI collaborated with other state owned organizations (see table 7) mainly Kenya Seed Company, Pyrethrum Board of Kenya, Kenya Sugar Board and East African Breweries, a local multinational corporation to develop high yielding varieties of commercial crops.

Table 7: Collaboration with local agro-para-statals (Plant Breeder's Rights Applications)

Plant	Collaborators	Number
Pyrethrum	Pyrethrum Board of Kenya	23
Dry Beans	Kenya Seed Company	5
Bread wheat	Kenya Seed Company	18
Barley	East African Breweries	3
Sorghum	Kenya Seed Company	2
Finger millet	Kenya Seed Company	2
Proso millet	Kenya Seed Company	1
Maize	Kenya Seed Company	27
Rhodes Grass	Kenya Seed Company	5
Coloured Guinea Grass	Kenya Seed Company	1
Setaria Grass	Kenya Seed Company	2
Congo Signal Grass	Kenya Seed Company	1
Pasture Grass	Kenya Seed Company	5
Sunflower	Kenya Seed Company	3
Suger Cane	Kenya Sugar Authority	6

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Research and Innovations at KARI

The Research activities in KARI are organized in terms of long-term programs and projects. These include researches on food crops like cereals, root and tuber crops, legumes and pulses; horticultural and industrial crops research on flowers, vegetables, fruits, fiber crops, herbs and spices; animal production and range research on dairy, beef, small ruminants, poultry, pigs, pastures and fodder crops, and range; Animal health research on livestock diseases; Socio-economics and biometrics for crop, livestock and natural resources including impact assessment, priority setting, market and policy research.

The other areas are land and water management, which includes soil fertility, survey and conservation, vegetation survey, agro forestry, irrigation and drainage; biotechnology research for crops and livestock improvement including development of livestock vaccines and diagnostic kits. Other crosscutting non-research programs nationally coordinated from the headquarters are Seeds and Germplasm conservation, Agricultural Research and Investment Services (ARIS), and Agricultural Technology and Information Responsive Initiative (ATIRI).[144]

Six hundred and twenty-seven (627) research and innovations were reported at KARI between 1990 and 2005 (see table 8 below). Of these, one hundred and ninety-six (196) were on crop varieties, two hundred and fifty-nine (159) on crop management and harvesting technologies, fifty-two (52) on soils and water resource management, sixty-eight (68) were on animal health and production and fifty-two (52) on livestock health.

Table 8: Research and innovations conducted in KARI between 1990 and 2005

Category of Innovation	Number	Percent of total %
Crop Varieties	196	31.26
Crop Management and Post harvest Technologies	259	41.31
Livestock Health	68	10.85
Soil and Water Resource Management	52	8.29
Animal Production and Management	52	8.29
Total	627	100

[144] Kiome, 2005:4.

41.3% of the research and innovation conducted by KARI was in crop management and post harvest technologies, while crop varieties accounted for 31.2% of the total research and development. Again, food crop varieties recorded the highest number of innovations at two hundred (200), food crop management innovations at one hundred and nineteen (119) and crop management in cash crops was at fifty-two (52) cases.

Protection of Innovations at KARI

Currently, a newly instituted intellectual properly officer deals with the matters relating to IPR in KARI. The institution is in the process of developing an IP policy, which will include undertaking an IP audit to direct the institution's focus and strategy. The audit exercise will be largely dependent on availability of donor support as it is estimated to cost approximately USD 400, 000.

KARI reported a total of six hundred and twenty–seven (627) innovations, of which Plant Breeders' Rights (PBRs) protection was pursued for one hundred and fourteen (114) of the reported innovations (table 9 below), and fourteen (14) granted trademark protection. Of the one hundred and fourteen (114) innovations forwarded for PBRs, eighty-three (83) innovations were undertaken in research collaboration with other organizations. It is notable that of the total one hundred and fourteen (114) PBR applications, only twenty-six (26) have been forwarded to the Ministry of Agriculture for gazzetment. KARI's inability to pay processing fees is to blame for their dismal performance in PRB (see table 10 below).

A constraint noted by the officials at the institution with regard to this delay was the long and expensive procedure. Also reported was the lack of lab note books by researchers (researchers keep own journals), whereas good lab practice requires that there should be lab note books certified and verified by an independent person, and in the event of an inventive step, the record may be used as a proof, and thus support in IP protection.

Benefits of Protect-able Innovations at KARI

Biotechnology has offered opportunities to reduce/overcome agricultural production constraints that are difficult, time consuming or impossible to cope with through conventional research methods on plant, animal and microbial studies. These technologies have been beneficial in food, crop and livestock management. It has resulted in improved and bio-fortified food crop varieties resistant/ tolerant to pests and diseases, food crop varieties tolerant to drought and with improved nutritional value, bio-fortified industrial and fodder crop varieties resistant to pests, technologically improved vaccines against priority livestock diseases, diagnostics against priority livestock and plant diseases, and inoculants for improved soil nitrogen and phosphorous in acid soils developed, validated and released.

Horticulture represents an *important sector*. It supports food security, income generation for farmers, foreign exchange earnings for the country, employment and poverty alleviation. Nationally, an estimated 2.6 million people are employed in the sub-sector, and it represents an important growth sector for small-scale farmers. In 2004, exports earned the country KShs 39.5 billion. The principal exports included vegetables, fruits and cut flowers. Cut flowers contributed 53.1% of the horticulture export volumes, while vegetables and fruits shares were 34.8 % and 12.1% respectively.[145] The major vegetables produced are french beans, runner beans, okra, snow pea, as well as packaged mixed vegetables, while fruits include macadamia nuts, avocados, mangoes, passion fruit, and pineapples.

KARI and TRIPS

Innovation and intellectual property, including biotechnology and plant breeder's rights, are critical in ensuring food security. KARI, as the state research organization charged with research, therefore, comes into the picture critically as it has over time served both small scale farmers and large scale farmers in the country and the East African region.

[145] GOK, Economic Survey 2005

KARI works closely with the International Convention for the Protection of New Varieties of Plants (UPOV) that governs plant breeders rights (PBRs). Farmers' rights are the rights of farmers to use seeds they have produced season after season, and the right to sell those seeds to other farmers. PBRs are the rights of breeders and seed merchants to breed and sell seeds. KARI work closely with seed merchants like the Kenya Seed Company Ltd to which it sells seeds. The international IP regime is not keen on protecting farmers' rights. There is bias towards bio-patents and the argument is that it is difficult to protect farmers' rights because the owner cannot easily be identified.

As can be seen from the activities of KARI, biotechnology offers technical solutions which can contribute to increased agricultural production with reduced reliance on chemical inputs. It can also enhance food storage, the development of drugs and diagnostics, as well as mechanisms for environmental protection. However, the ability of developing countries to benefit from the new technology is limited by two emerging and interlocking trends. First, TNCs and states which have the technology are keenly pursuing IP, especially patent protection under TRIPS. Second, most technology owners are protecting these assets through trade secrets or keeping the know-how confidential. Relatedly, technology transfer has ceased to be a major concern of technology owners.

The importance of IP in agriculture has increased many-fold. In the past the use of IP in agriculture was comparatively limited. With greater awareness of the economic importance of biotechnology and genetic resources, and the expanded role of private firms in agricultural R&D, the use of IP to protect new developments has become common practice.

As can be gleaned from the sponsors of research activities conducted by KARI, agribusiness TNCs are underwriting most of that research in biotech in Kenya, using Kenya's genetic resources. These TNCs are also able to control the development and diffusion of appropriate technologies by directly influencing research programmes at KARI and related institutions through engaging Kenyan scientists working for the TNCs

to work on a KARI programme funded by the TNC; or paying the educational fees for a Kenyans and securing their results.

Controlling technology through IP has been further strengthened by the fact that some of the biotechnology patents have very broad scope. Their coverage is not restricted to a specific crop or a technique. In many cases they cover any method for the development of a product (such as a genetically modified plant) in any crop. One of the most widely discussed broad patents was a patent granted to Agracetus, a leading biotechnology company. The patent gave it rights to all genetically engineered cotton plants and seeds, regardless of the method used to engineer the plant. Similar patents with wide coverage have been awarded to a number of firms.[146]

It is a matter of grave concern because Kenya and a number of developing countries are keen on developing biotechnology which is based on local agricultural and environment, including the development of genetically engineered plants with pest resistance and other desirable characteristics. Research has shown that the impact of IP on local development of agricultural biotechnology is likely to be strongly negative because of the tight control maintained by firms from developed countries. This partly results in restriction of the freedom of researchers in developing countries to develop these technologies or modify plant species. For instance, often, the results of a research programme have the effect of displacing farmers. Moreover, the plant and animal diseases, or plant and animal characteristics most critical to Kenyan farmers are rarely researched into.

[146] See Posey & Dutfield, *op. cit.*; cf. C. Juma *The Gene Hunters: Biotechnology and the Scramble for Seeds* Zed Books, London & Princeton University Press, Princeton, New Jersey (1989)

3.2. KENYA MEDICAL RESEARCH INSTITUTE (KEMRI)

Background

KEMRI is a medical research institute that develops and disseminates appropriate health science technologies. It contributes to strengthening of the national and regional health care delivery capacity. The institute was established in 1979 under the Science and Technology (Amendment) Act of 1979 as the national body responsible for carrying out health science research in Kenya. Under the Act, the mandate of KEMRI is to carry out research in the field of biotechnological sciences; to co-operate with other organizations and institutions of higher learning in training programs and on matters of relevant research; to liaise with other research bodies within and outside Kenya carrying out similar research; to disseminate research findings and; to co-operate with the Ministry responsible for research, the National Council for Science and Technology and the Medical Science Advisory Committee on matters pertaining to research policies and priorities.

Institutional Capacity at KEMRI

The institute currently supports a network of ten research centers (Appendix 2) based in different locations in Kenya, with seven in Nairobi, one in Kisumu, one in Busia and one in Kilifi. Areas of research and innovations covered include treatment and management of diseases, diagnostic kits, identification of useful traditional medicines, and healthcare in general, among others. At the time of this study, the total human resource at KEMRI stood at 1,535 of which 50 % were researchers and/or scientists. Table 11 and chart 4 below provides a summary of the human resource in KEMRI.

Table 11: Human Resource at KEMRI

Category	KEMRI	%
Research	307	20
Technologists	461	30
Technicians	-	-
Administration & Support	767	50
Total	1535	100

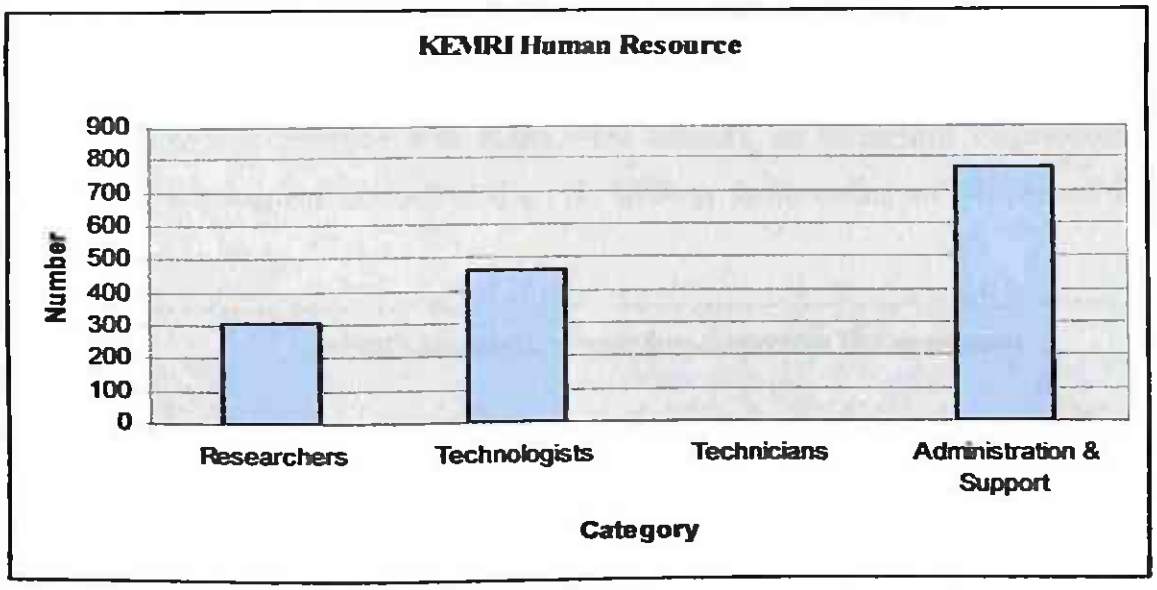

Chart 4: KEMRI Human Resource Distribution

Investment at KEMRI

The influence of investment on research and innovations was examined with the amount of budgetary allocation to KEMRI by the Government. Table 12 below presents the development and recurrent expenditure and earnings from the innovations at KEMRI.

Table 12: Development and Recurrent Expenditure Estimates at KEMRI

Year	Development Expenditure	Recurrent Expenditure	Earnings from innovations at KEMRI
1990/1	16,653,020	92,181,400	
1991/2	8,201,000	101,445,200	
1992/3	56,780,000	98,351,600	115,593,200
1993/4	10,668,180	122,167,460	115,593,200
1994/5	7,870,000	187,904,200	115,593,200
1995/6	2,470,000	211,936, 860	115,593,200
1996/7	4,063,640	220,977,820	121,677,052
1997/8	600,000	250,869,020	128,081,108
1998/9	320,000	286,763,320	134,822,219
1999/2000	143,500,000	279957020	141,918,125
2000/1	280,000,000	374,292,516	149,387,500
2001/2	157,250,000	477,864,288	157,250,000
2002/3	10,878,973	534,044,451	200,000,000
2003/4	-	852,244, 451	
Total	**699,254,813**	**4,090,999,606**	**1,495,508,804**

Source: GoK Development Expenditure and Recurrent Estimates (various years)

Table 12 above and chart 5 below show the expenditures and earnings over the period of the study at KEMRI. The level of development expenditure against recurrent expenditure in the institution stood at 17%. KEMRI invested approximately Kshs.699 million in development expenditure and Kshs. 4.0 billion, in recurrent expenditure. During that period the institution earned Kshs.1.5. billion from sales of protected innovations and diagnostic services.

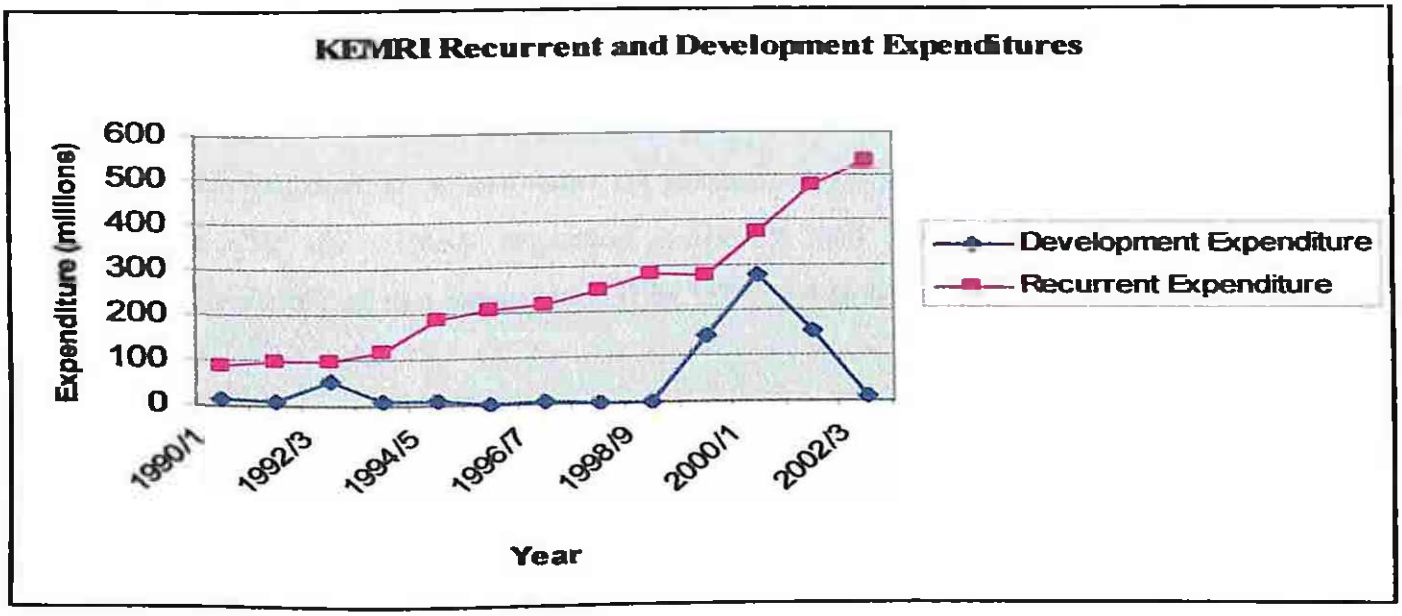

Chart 5: KEMRI Recurrent and Development Expenditures

In addition, the sale of KEMRI HEPCELL II to health care providers in the financial year 2002/2003 generated revenue of Kshs.5.5 million. The Institute also donated close to 500,000 test kits to Kenyan public hospitals, and an undetermined number to hospitals in the East African region. Furthermore, awareness creation on HIV/AIDS generated about Kshs.800, 000 in the years 2001/2002. It was also observed that availability of these kits have made testing more accessible and cheaper. This data indicate that there is tremendous opportunity for innovations to generate revenue for the institution.

Table 13: KEMRI Diagnostic Services Revenue

Years	Receipts	Growth rate
1999/0	2,542,458.4	
2000/1	3,432,611.45	1.4
2001/2	3,175,629.4	0.9
2002/3	3,605,541.95	1.1
2003/4	2,053,615.15	0.6
Total	14,809,856.35	

Research and Innovations at KEMRI

During this study, a total of eighty (80) research and innovations were reported at the Institute. Various areas of research and innovations were supported by a wide range of funding institutions. Wellcome supported remarkable proportion (20%) of the research and innovations on areas related to treatment of malaria, among others. TDR supported sizeable proportion (15%) of research and innovations in areas related to malaria in children, and transmission of leishmania among others. WRP supported considerable proportion (10%) of research and innovations on areas related to epidemiological research on leishmaniasis, evaluation of formulations for chemo-suppression in malaria among others. Of the eighty reported research and innovations, the eight that were considered to be critical are summarized in table 14 below.

Table 14: Major Research and Innovations at KEMRI

No.	Research and Innovations
1.	Treatment formulation that enabled the reduction of the treatment of leprosy from 18 months to 3 months.
2.	Treatment formulation for Tuberculosis that led to the reduction of treatment period from 6 months to 6 weeks.
3.	Treatment approach for Leishmaniasis that reduced treatment period from 30 days to 10 days.
4.	Development of appropriate formulation of micronutrients.
5.	Development of various formulations for the treatment of HIV/AIDS and opportunistic infections.
6.	Identification of useful traditional medicines for asthma, epilepsy, diabetes, mild hypertension, gout and malaria.
7.	Development of KEMRI Hepcell Kit for the diagnosis of infectious Hepatitis
8.	Development of Particle Agglutination (PA) Kit for the diagnosis of HIV

Besides the creation of new knowledge through research, the Institute has developed treatment formulations for different diseases, and advised the Ministry of Health on rational use of drugs in the clinical management of diseases. Remarkable effects of such advice were withdrawal of anti-malaria drug Daraprim from the market, and the withdrawal of Cloroquine as a first line drug in the treatment of malaria.

In addition, in partnership with GlaxoSmithKline Plc (GSK), KEMRI assisted in the development of a new drug, consisting of chlorproguanil hydrochloride and dapsone (*Lapdap*™) for the treatment of *Plasmodium falciparum* (*P.falciparum*) malaria, the most life-threatening malaria parasite. The combination of chlorproguanil hydrochloride and

dapsone, for the treatment of uncomplicated *P.falciparum* malaria in adults and children, has been developed specifically for use in sub-Saharan Africa where new interventions are urgently needed to address the risk of mortality and morbidity from *P.falciparum.* The research on the drug had been going on for ten years.

Protection of Innovations at KEMRI

By the time of this study, KEMRI had reported eighty innovations. Among these innovations, seventy two or 90% were undertaken in collaboration with other agencies and donors. Again, of the 80 innovations reported at KEMRI, twenty three or 31% resulted into products or processes that had potential of being protected. While the collaborating agents maintaining protection of twenty two innovations (27.5%), the Institute had undertaken trade mark protection for three innovations (3.75%) namely KEMRON, KEMRI HIV PA KIT and KEMRI HEPCELL II, and has placed three plant extracts patent applications to KIPI. The chart below shows the state of protection of innovations at KEMRI.

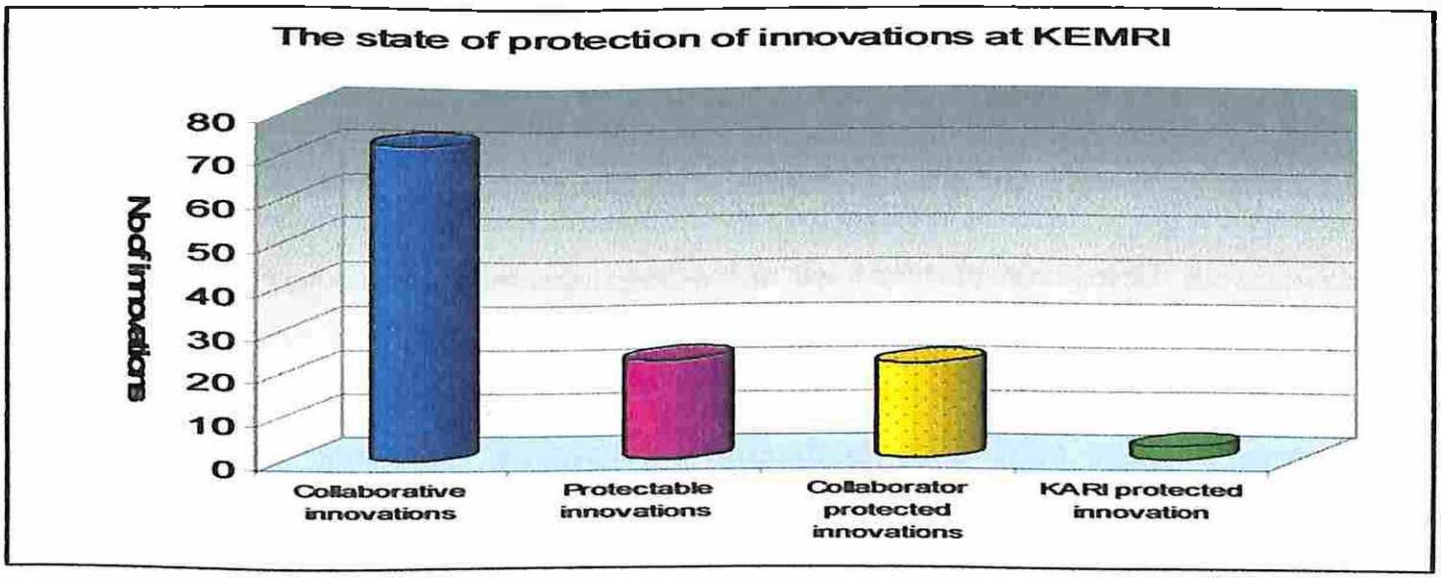

Chart 6: Status of protection of innovations at KEMRI

Development and the intellectual property protection fiasco surrounding KEMRON is a classical reflection of the IP malady faced by public sector research institutions in Kenya.

KEMRON is the registered trade name for the invention on Improved Formulation of Low-dose Interferon Alpha. Scientific research on KEMRON formulation was carried out by KEMRI in collaboration with Hayashibara Biochemical Lab in Japan and a U.S based organization, Amarillo Cell Culture Company Inc through joint financing. It was reported in 1990 to have promising potential for the management of HIV/AIDS and treatment of its opportunistic infections. KEMRI made patent application to African Regional Industrial Property Organization (ARIPO) in February 1990 through the office of the Attorney General, given that Kenya at the time did not have a law in place protecting IP. KEMRI was granted a certificate of patent under ARIPO.

ARIPO granted KEMRI patent no. AP 132 in May 1991 for the invention KEMRON for a period of seven years, having effect in ten designated contracting African countries. After 1998, the drug became free for all after the expiry of the seven years as KEMRI did not maintain the patent by meeting the annual fees. The Institution lacked the government support to pursue protection on the product. Even locally the product was not approved by the government as an alternative therapy of HIV, therefore not taken up for use as one of the drugs for managing HIV. This drug was, however, taken up and commercialized by MS Distri-Pharma Group S.A, under license from F. Hoffmann-La Roche A.G of Switzerland, under the trade name IMMUNOPLEX-N, and is now in circulation in the Kenyan market.

The study established that the top management at the Institute recognizes the importance of safeguarding their inventions and innovations and reported that they carry out regular consultations with KIPI through the office of the director. The Institute has set up an IP management office headed by an assistant director of production and marketing. This office is charged with responsibility to maintain inventory of innovations and apply for IP protection from KIPI on behalf of the institute. In addition, the institution has in place an IP policy. In order to strengthen protection of its innovations, the Institute has planned to establish a database for inventory and to hold a series of technical workshops to educate their scientists and extension officers on importance of procedures for the protection of innovations.

The Institute, however, noted that their greatest concern in terms of R&D and resultant protections is the lack of government's good will and commitment to protect innovations, utility models and other ensuing products and processes. The government's yearly budgetary allocation to R&D is 0.1%, and this has hindered development of innovations and their protections in the country. The fact that Sessional Paper No. 2 of 1997 on Industrial Transformation to the year 2020,[147] makes no mention of higher education and the role of research institutions in R&D development and its subsequent contribution to industrialization and self sustainability.

Collaborating Agencies at KEMRI

There is a substantial presence of collaborating agencies at KEMRI. At the time of the study KEMRI maintained collaborations with twenty-six (26) collaborating agencies, mainly universities and pharmaceutical companies are summarized in the table below.

Table 15: KEMRI Collaborators

No.	Collaborator
1.	US Army Medical Research and Material Command (USAMRMC)
2.	United States Agency for International Development (USAID)
3.	Walter Reed Army Institute of Research (WRAIR)
4.	Japan International Cooperation Agency (JICA)
5.	Institute of Tropical Medicine and Infectious Diseases (ITROMID)
6.	Centers for Disease Control and Prevention (CDC)- Atlanta, Georgia, USA
7.	World Health Organization (WHO)
8.	Suez Canal University – Egypt
9.	International Development Research Centre (IDRC) of Canada
10.	Wellcome Trust, UK,
11.	British Medical Research Council (UK)
12.	Royal Tropical Institute, Amsterdam
13.	World Association of Industrial and Technological Research Organization (WAITRO)
14.	Ethiopia Health and Nutrition Research Institute- Addis Ababa, Ethiopia
15.	National Institute of Medical Research (NIMRI) – Dar es salaam, Tanzania
16.	Mahidol University – Bangkok, Thailand
17.	Noguchi Institute of Medical Research, Lagos, Ghana
18.	University of Zambia Medical School, Zambia
19.	Medical Research Council, South Africa
20.	London School of Tropical Medicine and Hygiene

[147] Government of Kenya, 1996

21. Makerere University Medical School, Uganda
22. Virus Research Institute, Entebbe, Uganda
23. Blair Research Centre, Harare, Zimbabwe
24. Liverpool School of Tropical Medicine
25. Kenyatta National Hospital
26. University of Nairobi

These agencies provided up to 60 % of the research funds and provided substantial technical assistance through researchers and/or technologists. The research institutions' infrastructure was also largely attributed to donor support. The study notes that without this support the level of R&D in the country would be lower. It was observed, as in the case of KARI, that some of the IP that accrues from such collaborations are not claimed directly by the Kenyan scientists or KEMRI as it is viewed as public knowledge by KEMRI Collaborators.

Benefits of Pretect-able Innovations at KEMRI

The relationship between health and economic growth is indisputable. It had been noted that there is a high prevalence of HIV/AIDS in Africa affecting a large population of the productive bracket. This among other diseases has not spared Kenya. KEMRI, through its innovations has offered opportunity to reduce/overcome the threat of various diseases. The table below provides a summary or benefits that have accrued from the protected innovations at KEMRI.

Table 16: KEMRI protected innovations and their impact on Public health

Innovation	Description	IP and Technology Transfer (TT) details	Overall Impact
KEMRI Hepcell II kit	A simple easy to use Hepatitis B diagnostic kit that does not require electricity.9+	- TT from Japan to Kenya. - Trademark protection sought - Large scale production to be done at the Institute	- Contribute to strengthening of national and regional blood safety capacity -Enable the diagnosis of Hepatitis B in remote areas
H IV 1 and 2 Antibody detection kit	A simple easy to use diagnostic kit that does not require electricity	- TT from Japan to Kenya - Large scale production at the Institute	- Contribution to prevention and control of HIV/AIDS - Strengthening the national and regional blood safety capacity
TB diagnostic aid and decontaminant	A simple and standardized leaching agent that will aid TB diagnosis and decontamination	- Application for patent protection at PTC level commenced. -Commercialization via contract manufacturing being explored	Immense contribution to prevention and control of TB which is a public health problem in the region.
Two plant extracts showing invitro activity against TB	One of the extracts shows activity against Multi drug resistant TB	- Patent application for the two plant extracts sought. - Seeking a suitable partner to carry out further R and D.	Contribution to TB treatment especially Multi drug resistant TB
Plant extract showing activity against Herpes Simplex Virus (HSV)	In vitro activity against HSV, a common opportunistic infection among HIV/AIDS patients	Patent application for the plant extract. Seeking suitable partner for further R and D	Providing an effective alternative for treatment of HSV, drugs currently used failing due to resistance.

KEMRI and TRIPS

That there are vibrant research and development activities taking place in KEMRI is not in doubt. It is also evident that domestication of TRIPS agreement has positively affected the institution as can be inferred from the fact that the organization is liaising with KIPI to have all its innovations and inventions protected and has put in place an IP policy. That some of its products have been protected and an office dealing with IP established are indicators that IPR is taken seriously by the institution.

KEMRI is charged with the mandate of research and development in the field of health and medication. In Kenya, the prices of drugs are very high, partly because of patents and limited R&D on diseases affecting local Kenyans. With the signing of TRIPS agreement came the concern with regard to essential drugs developed by pharmaceutical companies

in developed countries, who as owners of patents decided to raise their prices. Before TRIPS, up to 50 countries did not grant patents to pharmaceuticals.[148] Under TRIPS all developing countries are required to grant patent protection to drug companies for a minimum of 20 years. This exacerbates reverse equity where drugs cost more in developing countries like Kenya than they do in developed countries. Kenya has initiated a strong patent protection in line with Article 28 and Article 70 (8) of TRIPS without price control commonly used in European countries.

Kenya has not fully taken advantage of Article 27 of TRIPS that permits the complete exclusion from patentability of certain inventions where necessary to protect public order, morality, and health or to avoid serious prejudice to the environment because like many other developing countries it focused on denying/rejecting TRIPS, is uncritically complying with TRIPS absolute terms and due to ignorance and lack of technical and institutional capacity by some critical actors even though Kenya has enacted the relevant opt out clause. Section 58(2) of Kenya's IPA 2001 limits a patentee's rights.

Similarly, Kenya has not fully utilized the clause on compulsory licensing provided for in Article 31 of TRIPS because it is not clear whether governments can only grant a compulsory license to a domestic manufacturer and Kenya has little capacity in that area. The country has also not been able to take advantage of the TRIPS provisions which allow for manufacture of generic medicines in the country due lack of capacity. KEMRI as the premier public medical research organization should be facilitated to take advantage of these provisions in TRIPS agreement to enable Kenya benefit from them especially with the HIV/AIDS burden that the country has to bear.

[148] See Carlos Correa's observation in *ibid.*

3.3. KENYA INDUSTRIAL RESEARCH & DEVELOPMENT INSTITUTE (KIRDI)

Background

KIRDI was established under the Science and Technology Act Cap.250 in 1979 to conduct industrial research and development; carry out needs assessment for skill development within the industry; design and implement business development support framework for cleaner production, industrial and technological information dissemination, and technology transfer and; training, capacity building and extension services to industry. In deed KIRDI's mandate is to undertake research in industrial and allied technologies including civil, mechanical, electrical, chemical engineering, agro-industrial (food), power, mining, and ceramic technologies.

KIRDI is expected to enhance the national industrial technology innovation process as a strategy towards rapid socio economic development; contribute to the development of sufficient capacity for industrial research and development; contribute to the creation of the national wealth in disembodied technologies that are appropriate and accessible to micro and small enterprises in Kenya; promote the development of a strong capacity for primary engineering so as to reduce dependence on imported plant, machinery and spares and; facilitate access by local enterprises to business development services including cleaner production and industrial information.

Institutional Capacity at KIRDI

At the time of this study, the Institute had five (5) service centers and three core research programs in the areas of poverty reduction and stimulation of economic growth as summarized in table 17 below.

Table 17: KIRDI'S Research Programs

No.	Research And Development Programs	Activities
1.	Technology Development	• Development of technologies for reduction of food losses and value addition. • Development of cheap, easily replicable food processing technologies ideal for micro and small enterprises in Kenya.
2.	Technology and Engineering Capacity Building	• Engineering tooling and metal product development; • Technology adaptation and dissemination; • Efficient energy utilization.
3.	Technology Transfer	• Environment and Cleaner Production technologies; • Leather and textile technologies; • Business development services; • Ceramics and building materials, and; • Information Technology Networks.

The research programs in KIRDI are substantially centralized within Nairobi. KIRDI, however, maintain collaboration with various companies distributed countrywide for research, innovations and technology transfer.

At the time of the study the total workforce at KIRDI was considerably small, standing at 228, of which 28.1 % were either researchers and/or scientists. The table and chart below provides a summary of the human resource distribution.

Table 18: Human Resource at KIRDI

Category	KIRDI	%
Researchers	29	12.7
Technologists	35	15.4
Technicians	46	20.2
Administration & Support	118	51.7
Total	228	100

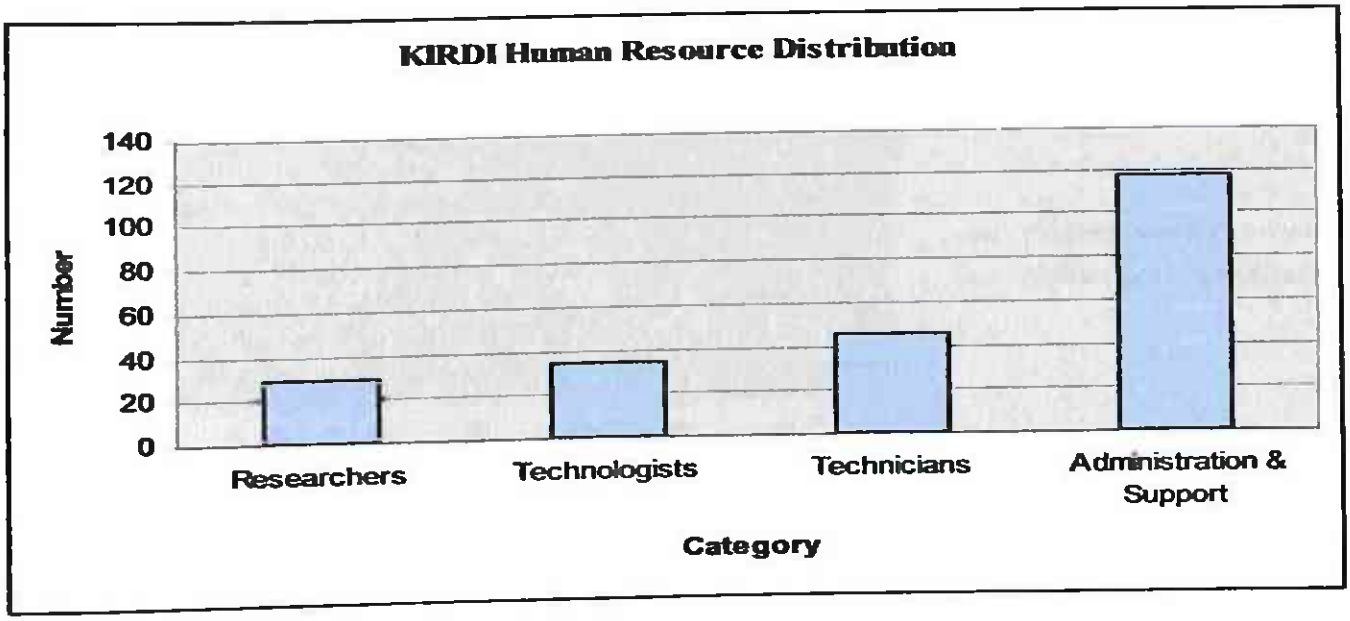

Chart 7: KIRDI Human Resource Distribution

Investment at KIRDI

The influence of investment on research and innovations was examined with the amount of budgetary allocation to KIRDI by the Government and the collaborating agencies; table 19 below presents the development and recurrent expenditure estimates and earnings from innovations at KIRDI.

Table 19: Development and Recurrent expenditure and Earnings from innovations at KIRDI

Year	Development Expenditure	Recurrent Expenditure	Earnings from innovations
1990/1	3,083,440	25,725,580	-
1991/2	6,212,160	31,922,400	-
1992/3	5,915,420	30,780,180	60,000
1993/4	6,491,100	47,366,980	60,000
1994/5	12,420,000	72,047,980	60,000
1995/6	14,400,000	79,702,220	400,000
1996/7	14,200,000	81,436,820	400,000
1997/8	4,195,060	100,743,340	410,000
1998/9	1,400,000	109,418,420	430,000
1999/2000	6,956,960	106,940,700	645,000
2000/1	6,956,960	98,540,000	960,000
2001/2	2,500,000	131,232,560	10,000,000
2002/3	5,842,804	134,057,010	124,057,010
2003/4	52,500,010	124, 358, 092	-
Total	**143,073,914**	**1,174,272,282**	**137,482,010**

Source: GoK Development Expenditure Estimates (various years)

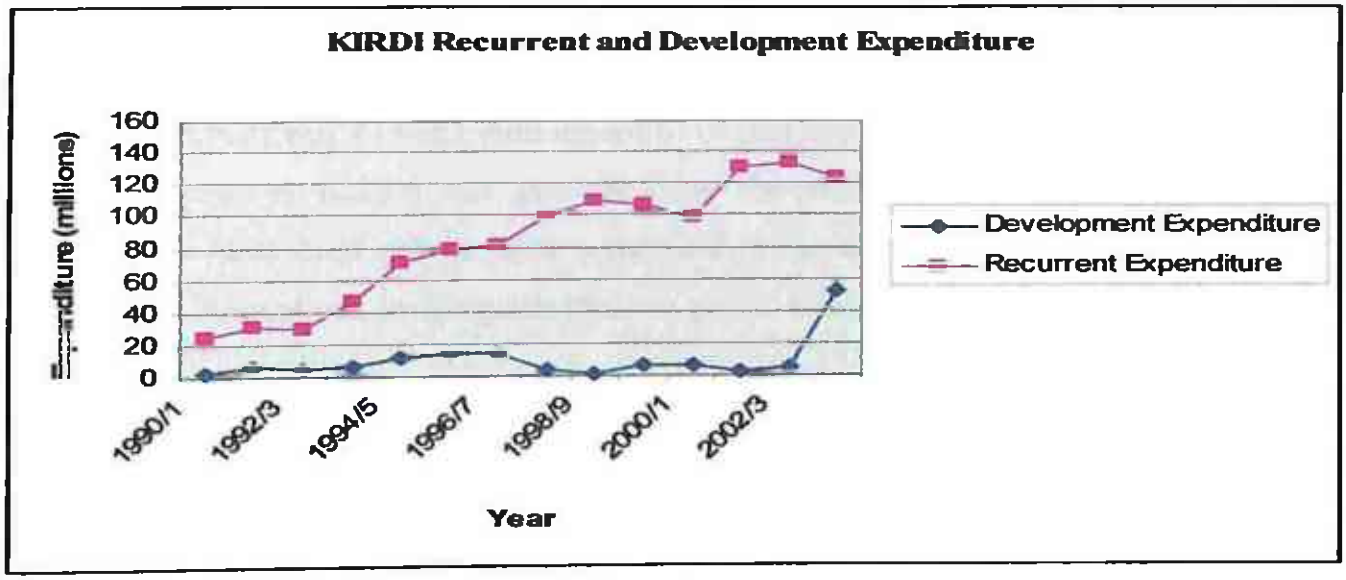

Chart 8: KIRDI Recurrent and Development Expenditure

KIRDI invested approximately Kshs.143 million during the period 1992 and 2004 in development expenditure. During the same period it spent approximately Kshs.1.1 billion on recurrent expenditure. The returns from KIRDI's activities at the same time were Kshs.137 million.

The Institute has expanded its revenue generation from Kshs.60, 000 to Kshs.124, 057,010, a remarkable increase by a factor of 2,067.6. The highest growth rate was achieved in 1995/6, 2001/2, and 2002/3 respectively. Specific areas that contributed to increased revenue include vegetable oils, and development of wet blue leather fungicide used in leather industry, and training provisions to technicians from various industries in the country. It is important to point out that the Institute support innovations in areas that have impact on various sectors of industrial development as summarized in table 21 in the subsequent pages.

Collaborating Agencies and KIRDI

A substantial presence of collaborating agencies was noted at KIRDI (see Table 20). During this study, it was observed that KIRDI collaborated with twenty agencies. This study observes that these agencies provided a large percentage of the research funds and

provided substantial technical assistance through researchers and/or technologists. The research institutions' infrastructure was also largely attributed to donor support. As was observed in KARI and KEMRI with regard to IP that accrues from collaboration, most of the innovations at KIRDI are protected by the collaborators. Some international collaborators have even put in place policies that bar the institution from claiming IP rights on the innovations as it regards them as public knowledge.

Table 20: KIRDI Collaborators

No.	Collaborators
1	The European Union
2	Denmark and Germany provide technical support and expertise
3	International Fund for Agricultural Development (IFAD)
4	It is funded by the International Foundation of Science (IFS).
5	African technology Policy Studies Network (ATPS).
6	The Organization of Prohibition of Chemical Weapons (OPCW)
7	Council for Science and Industrial Research (CSIR)
8	University of Pretoria both of South Africa
9	Institute of Food Research (IFR) of UK
10	Universidade Eduardo Mondlane of Mozambique
11	University of Aveiro, Portugal
12	World Association of Industrial and Technological Research Organization (WAITRO)
13	International Institute of the Tropical Agriculture (IITA)
14	World Bank
15	International Development Research Centre (IDRC) of Canada
16	United Nations Development Organization (UNIDO)
17	The Federal Republic of Germany
18	United Nations Development Programme (UNDP)
19	United Nations Environment Programme (UNEP)
20	Commonwealth Scientific and Industrial Research Organization

Research and Innovations at KIRDI

During this study, a total of forty-six (46) research and innovations were reported at the Institute, details of which are presented in Appendix 5, covering leather processing, leather fat liquoring products, production of ceramic glasses, laboratory bench power supply, acetic acid from molasses and wood and water based ink. Table 21 below presents some of the R&D in various industry applications.

The leather fat liquoring products, for example, involved use of locally available raw materials. These products resulted in an estimated saving of Ksh.120 million that was being spent annually in importing fat liquoring products. Within this period, at laboratory scale, the division was able to produce three hundred liters of the product, which was sold both to LDC of KIRDI as well as to several Jua Kali tanneries within the country. The local power supply units were developed for use in institutional laboratories for the promotion of science and technology within secondary schools and colleges in the country. The sorghum beer was developed as a suitable malting and brewing technology for use by small/medium scale-breweries to produce lager type beer from sorghum. It is also based on indigenous cereal that is most suited for cultivation in the semi-arid areas of Kenya.

It is useful to note that most R&D undertaken at the institution is demand driven, mainly by local industries. Noteworthy are the local entrepreneurs assisted through project incubation programs, where technologies are adopted to suit the need and environment of the entrepreneur as well as providing an affordable alternative. This is observed to contribute to technology transfer.

Table 21: Innovations and Technology Transfer at KIRDI

No.	Industry	Activity
1.	Vegetable Oils Industry	Screening of raw materials and providing consultation on extraction, refining and hydrogenation methods.
2.	Ceramic Industry	Advised on the construction of suitable kilns, screening of local clays for utilization in various products, and production of glazes from local raw materials.
3.	Essential Oils Industry	Defining extraction methods.
4.	Leather Industry	Processing of Nile Perch (Mbuta) skins into novelty leather, development of wet blue leather fungicide, and training to technicians from other tanneries in the country.
5.	Traditional Foods Sector	Methods of processing fermented *uji* with a view to improving its quality, nutritional value, shelf life and safety of the consumer.
6.	Chemical Industry	Development of water-based writing ink made from locally available materials. The technology is expected to bring the micro and small enterprises into the ink manufacturing fraternity thus resulting in job creation and poverty alleviation.

While direct revenue to the institute appears to be modest, the impact of the innovations is much more promising on the industrial sector.

Protection of Innovations at KIRDI

KIRDI has a newly instituted intellectual properly officer dealing with the matters relating to IPR. The institution is in the process of developing an IP policy. In addition, the institution has undertaken a preliminary IP audit to direct the institution's focus and strategy, with the guidance of KIPI. With regard to IP protection, a large proportion of the technical assistance at the Institute has been provided to various companies and small and medium enterprises that in turn, own the subsequent innovations and carry out the efforts related to protections. However the Institution has been pursuing protection of some of its innovations and the most notable involved application for protection of the water based writing ink in 1998. The other remarkable initiative involved application for protection for innovation of fish leather processing. While this process has been taken up and protected elsewhere and has resulted in substantial commercial gains in Uganda, Tanzania and Italy, it was not protected in Kenya due to conditions provided by UNIDO, the sponsoring agency at the time. UNIDO's policies require that research carried out under its assistance, and the ensuing innovations be treated as public property for public welfare, which prohibits the efforts of the scientists to protect ensuing innovations.

KIRDI and TRIPS

The aspect of TRIPS that is most relevant to KIRDI is technology transfer. Looking at the findings of this study, it is apparent that KIRDI has in deed struggled to fulfill its mandate under very difficult circumstances. Most expenditure at KIRDI is geared towards recurrent budget as opposed to research. Similarly, the bulk of the staff in the organization is middle and low grade, with very few researchers and technologists. It is no wonder that only a few inventions and innovations have been reported by the organization. However, it is heartening to see that the earnings from the innovations have increased tremendously in the recent past-an indication that with better funding and more researchers, the organization could be able to underwrite most of its activities.

The examination of research activities at KIRDI also reveals some shortcomings of TRIPS Agreement with regard to technology transfer. Most of the successful researchers reported in KIRDI are in areas of technology that cannot be tried and tested. This is an indication that there is little technology transfer taking place from the developed world to developing countries like Kenya. This confirms the assertion by the opponents of TRIPS that the western negotiators were not enthusiastic about technological transfer, even though article 7 of the agreement stipulated that "the protection and enforcement of intellectual property rights should contribute to the promotion of technological innovations and to the transfer and dissemination of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations."[149] It also exposes the vagueness of TRIPS agreement commitment to developing countries and exposes gaps in its provisions.

Indeed Pedro Roffe observes that because technology is owned privately by TNCs/Corporations, the home governments promise to transfer technology to developing countries is a sham. Furthermore their regulatory capture by the multinationals ensures that nothing of substance reach countries like Kenya. Developing countries including Kenya are further isolated from the benefits of technology transfer by article 66 (2) and 67 that provides that

> *"Developed country members shall provide incentives to enterprises and institutions in their territories for the purpose of promoting and encouraging technology transfer to least developed country members in order to enable them to create a sound and viable technological base."*[150]

It is clear from the above findings in KIRDI that not much technology transfer has occurred into the organization, with respect to those from developed countries, however, it is noteworthy that technologies have been developed and some adopted that suit the needs and the Kenyan situation. Low levels of technology transfer could perhaps be attributed to the fact that Kenya still has a policy of weak IP in technology hence

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[149] http://www.wto.org/english/docs_e/legal_e/27-TRIPS_03_e.htm

[150] Ibid

resulting into reduced quality of technology transferred.[151] Studies have revealed that those technologies transferred to developing countries tended to be significantly older than those transferred to industrialized economies.[152] Analysis by the UK's DfID's Commission on Intellectual Property Rights puts the circumstance that Kenya finds itself in with regard to technology transfer most succinctly. It pointed out that companies in developing countries can no longer compete on the basis of importing "mature" technologies from developed countries and producing them behind tariff barriers. The problem is less about accessing the sophisticated technologies that are required to be competitive in today's global economy. TRIPS agreement has strengthened the global protection offered to suppliers of technology, but without any counterbalancing strengthening of competition policies globally. It is therefore evident from the above that for most developing countries with weak technological capacities there is very little benefit in terms of technology transfer to be gained by being TRIPS compliant. Furthermore, most technologies have to be homegrown to enable for utilization in the Kenyan environment.

3.4. OVERALL PROTECTION OF INNOVATIONS IN KENYA

In order to get a clear picture of the status of protection of innovations and inventions in public research institutions in Kenya, the study examined the registers of application and patents granted in Kenya between 1990 and 2003 in KIPI, trade mark processing between 1992 and 2002, and PBR applications and grant in KEPHIS.

3.4.1. Applications and Patents Granted in Kenya between 1990 and 2003

Studies have pointed out that there are very few applications for patents from resident Kenyans. For instance in 1988, only one (1) resident application was received compared to eighty-nine (89) from non-residents. Out of these applications, seventy-five (75) non-

[151] K.E. Maskus, *Intellectual Property Rights in the Global Economy* Institute for International Economics, Washington DC, 2000.
[152] Farok J. Contractor, 1980, "The profitability of technology licensing by US multinationals: a framework for analysis and an empirical study" 11 *Journal of International Business Studies* 40-63, cited in Maskus, *ibid.*

resident applications were granted along with the one (1) resident application.[153] In the 1987 figures, a hundred and twenty (120) non-residents applied for patent compared to nil residents. Futher, between 1980 and 1986, six hundred and seventy-five (675) non-resident patent owners were registered while no residents were registered in the same period.[154]

The scrutiny of national patent applications and patents granted between 1990 and 2003, indicate that only 25.1% were successfully granted patents, 33.5% were withdrawn or abandoned while 41.4 % undetermined. In the case of PCT national phase, 27% of the applications were granted, while 15.2% were withdrawn or abandoned, and 57.8% were undetermined. National industrial design applications were more promising with 58.6% of the applications granted, 6.4% withdrawn or abandoned, while 35.0% were undetermined. More interestingly, of the total 3920 patents under CAP 509 total registrations, only 3.4% were in force, while 96.6% are reported to have expired (see table 22 below). The available statistics indicate that no significant change has occurred in the number of applications since the promulgation of the Industrial Property Act 1989.

Table 22: Applications and Patents Granted in Kenya (1990-2003)

No.	Category	Number	App. in force or granted		App. Withdrawn, abandoned or expired		App. undetermined	
			No	%	No	%	No	%
1.	National Patent Applications	391	98	25.1	131	35.3	162	41.4
2.	PCT National Phase	230	62	27	35	15.2	133	57.8
3.	National Industrial Design Applications	515	302	58.6	302	58.6	180	35
4.	ARIPO Industrial Designs Designating Kenya	2033	1046	51.5	987	48.5		
5.	National Utility Model Applications	44	19	43.2	2	4.5	23	52.3
6.	ARIPO Industrial Designs Applications	86	62	72.1			24	27.9
7.	Patents Under Cap 509 Total Registrations	3920	134	3.4	3786	96.6		
8.	Patents Transmitted to ARIPO	26						
9.	Industrial Designs Transmitted to ARIPO	11						
10.	Patents Transmitted to PCT	6						
11.	ARIPO Utility Models Applications	1						
12	ARIPO Utility Models Registrations	1						

Source: KIPI Patent registry report August 2003

[153] See World Intellectual Property Organisation, (1988) *Industrial Property Statistics,1988,* WIPO, Geneva, in Kameri-Mbote, 2005, *Ibid*

[154] See World Intellectual Property Organisation, (1990) *Industrial Property Statistics, 1989*, WIPO, Geneva, in Kameri-Mbote, 2005, *Ibid*

From the data reflected on table 22 on applications and grants of industrial property in Kenya, it is very clear that there exist bottlenecks to successful registration of innovations and inventions in Kenya. This could imply that while awareness of importance of ownership of IP is growing as reflected in the number of applications, there is still lack of capacity in the institutions charged with the task of registration, enabling environment and adequate support for those intending to have their IP applications successfully registered. It is possible that the systems are not very responsive in terms of efficiency and or legislative capacity.

3.4.2. Trade Marks Processing in Kenya between 1992 and 2002

Among the innovations that have been protected through trade marks in Kenya between 1992 and 2002, there was an increase by 897, from 160 in 1992, to 1,057 in the year 2002 reflecting considerable oscillation, where a high growth rate of 2.7% occurred between 1992 and 1993 and a steady growth rate between 2000 and 2001 as shown in table 23 below.

Table 23: Trade Marks Processing in Kenya since 1992 -2002

Year	Cert. of registration	Growth rate
1992	160	
1993	434	2.71
1994	790	1.82
1995	821	1.03
1996	556	0.67
1997	600	1.07
1998	1,006	1.67
1999	1,013	1.01
2000	1,234	1.21
2001	1,500	1.21
2002	1,057	0.70
Total	**9,171**	

Source: KIPI, 2002

The rise in the number of applications and registrations of trademarks reflect increased awareness in Kenya for the need to protect inventions and technologies. This steady increase could partly be as a result of legal reforms that enhanced protection of innovations and technologies, particularly with Industrial Property Act, Cap 509 (1990)

and the new Industrial Property Act (No. 3) of 2001 in compliance with the TRIPS agreement.

3.4.3. Protection under Plants Breeders Rights

An examination of registry at KEPHIS of innovations on plants that have been protected under the Plant Breeders' Rights (see table 24 below) yielded a total of three hundred and twenty six (326 or 56.4%) applications made by foreign applicants, one hundred and thirty two (132 or 22.8%) by local public breeders, sixty-six (66 or 11.4%) by local private breeders, and fifty four (54 or 9.3%) by local joint public and private breeders. It is clear from the register that majority holders of PBRs are foreign firms. It is important to note that foreign applicants do not apply for protection of food and industrial crop varieties. Foreign holdings account for the majority of the rights (231 of the total 326) on ornamental crops, particularly on the rose flower (over 70%). Noteworthy, most of the local applications for PBRs are made by public research institutes like KARI and Kenya Seed company, who hold the majority of PBRs on food and industrial crops such as maize (25 out of 54), pyrethrum (23 out of 23) and tea (12 out of 33). The data confirms the important role of the foreign firms and public corporations in R&D, innovations, and trade. It brings to the foe the important fact in IP applications that foreign companies are interested in innovations geared primarily to commercial gains.

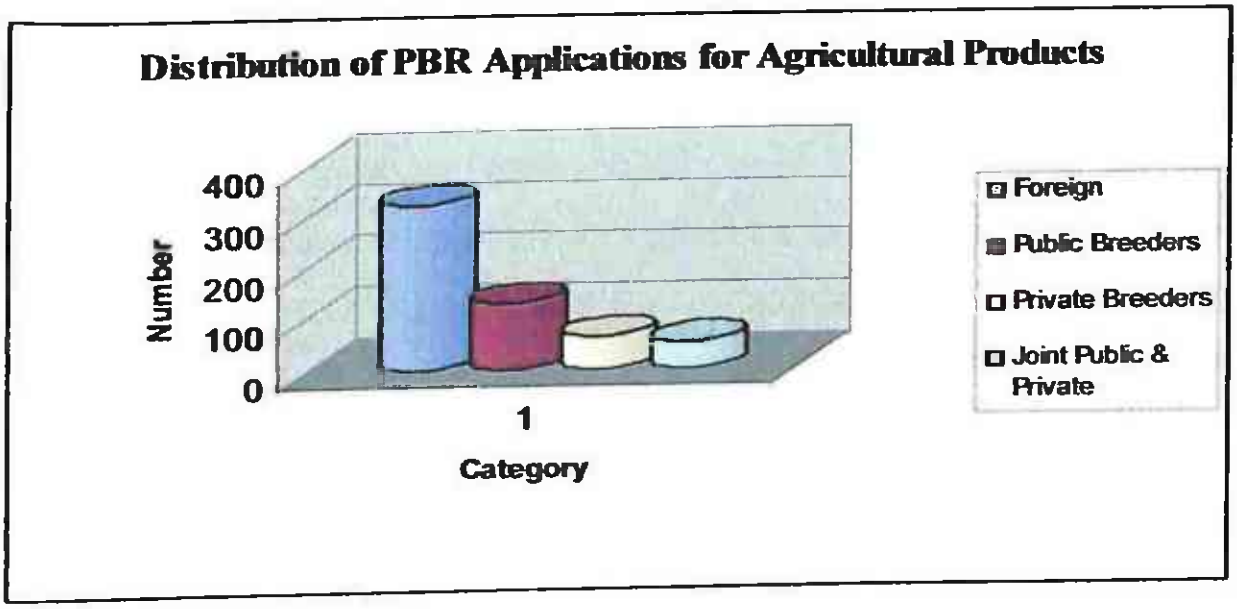

Chart 9: Distribution of PBR Applications for Agricultural Products to KEPHIS (2003)

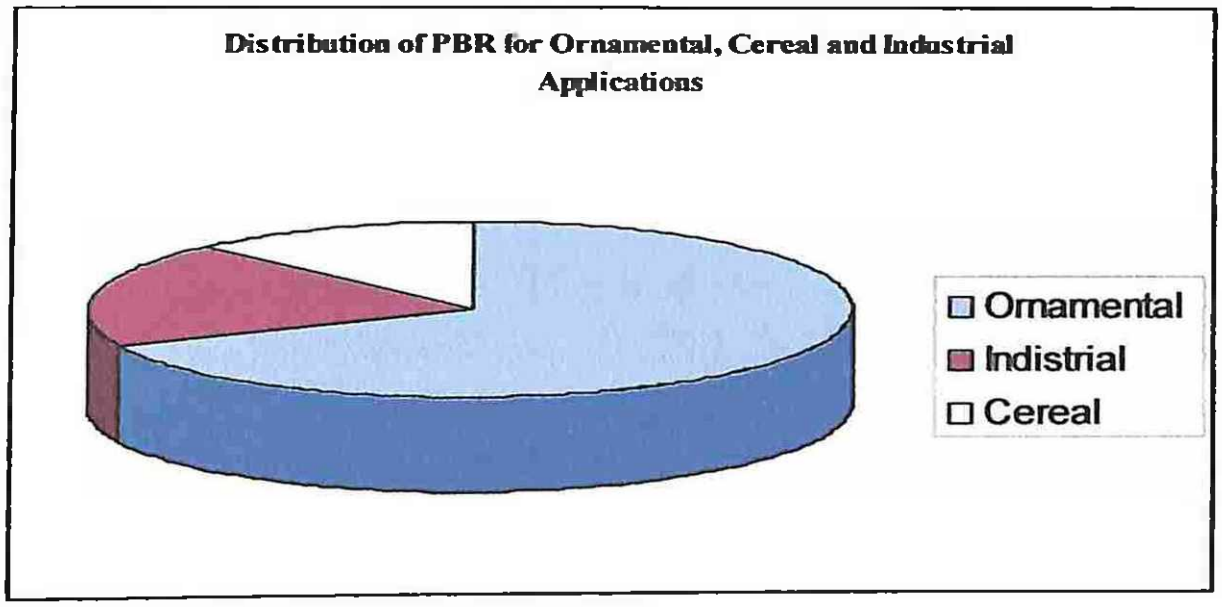

Chart 10: Distribution of PBR for Ornamental, Cereal and Industrial Applications

Table 24: Distribution of PBR Applications

Crop	Category	Source of Application				Total
		Foreign	Local			
			Public Breeders	Private Breeders	Joint Public & Private Breeders	
Oat	Cereal	-	1	-	-	1
Finger millet	Cereal	-	-	-	2	2
Barley	Cereal	-	-	7	-	7
Proso millet	Cereal	-	-	-	1	1
Pearl millet	Cereal	-	3	-	-	3
Sorghum	Cereal	-	2	-	5	7
Wheat	Cereal	-	4	1	25	30
Maize	Cereal	-	25	14	15	54
Tea	Industrial	-	12	21	-	33
Pyrethrum	Industrial	-	23	-	-	23
Coffee	Industrial	-	4	-	-	4
Cotton	Industrial	-	1	1	-	2
Macadamia nut	Industrial	-	4	7	-	11
Sugarcane	Industrial	-	6	-	-	6
Sunflower	Oil	-	1	-	-	1
Sunflower	Oil	-	5	5	-	10
Castor oil	Oil	-	2	-	-	2
Soybean	Oil	-	7	-	-	7
Bracharia	Pasture	-	1	-	-	1
Rhodes grass	Pasture	-	5	-	-	5
Guinnea grass	Pasture	-	1	-	-	1
Setaria	Pasture	-	2	-	-	2
Clover	Pasture	-	-	1	-	1
Pigeon pea	Pulse	-	4	-	-	4
Dolichos bean	Pulse	-	2	-	-	2
Runner bean	Pulse	-	-	1	-	1
Dry bean	Pulse	-	6	1	6	13
Peas	Pulse	7	-	-	-	7

Cow pea	Pulse	-	3	1	-	4
Mung bean	Pulse	-	2	1	-	3
Cassava	Root crop	-	2	-	-	2
Strawberry	Fruit	3	-	-	-	3
Passion fruit	Fruit	1	-	-	-	1
Raspberry	Fruit	1	-	-	-	1
Alstroemeria	Ornamental	25	-	-	-	25
Aster	Ornamental	1	-	-	-	1
Carnation	Ornamental	2	-	-	-	2
Eryngium	Ornamental	1	-	-	-	1
Gysophila	Ornamental	3	-	-	-	3
Limonium	Ornamental	8	-	-	-	8
Pelagonium	Ornamental	4	-	-	-	4
Phlox	Ornamental	4	-	-	-	4
Rose	Ornamental	231	-	-	-	231
Solidago	Ornamental	2	-	-	-	2
Tegetes	Ornamental	1	-	-	-	1
Calla Lilly	Ornamental	3	-	-	-	3
Amaranthus	Vegetable	-	-	4	-	4
Rape seed	Vegetable	14	-	-	-	14
Pepper	Vegetable	1	-	-	-	1
Sweet potato	Vegetable	1	-	-	-	1
Tomato	Vegetable	-	-	1	-	1
Irish potato	Vegetable	-	4	-	-	4
French bean	Vegetable	13	-	-	-	13
Total		**326**	**132**	**66**	**54**	**578**
Percentage (%)		**56.41**	**22.83**	**11.41**	**9.35**	**100**

Source: KEPHIS, 2003

3.5. SECTION CONCLUSION

As can be seen from the data gathered from the three institutions, it is clear that there is some attempt at implementing IP protection in all of the institutions with mild success as they have made an attempt to create institutions to deal with the issue of protecting IP. However, it is observed that IP protection and implementation is lowest at KIRDI.

It is also clear from the findings that the institutions under study (with the exception of KEMRI) do not yet have coherent IP policies and strategies to guide and direct them in matters of intellectual policy. This has resulted into loss of ownership of rights while undertaking R&D in collaboration with other organizations on new varieties. Again there is chronic lack of funds to undertake IP audit. This has led to lack of basic requirements, as well as accurate documentation of innovations at these institutions. None of the institutions have a dedicated IP Protection budget, a challenge that is worsened by the

long and expensive procedure for seeking protection with the IPR institutions for registration.

Even though there are opportunities for the institutions to benefit from their innovations through IPR, not much have been done to generate revenue through utilization of IPR of their innovations. For example KARI has given most of its varieties to Kenya Seed Company for a "token" of approximately Kshs. 5 million a year, where it would have made between Kshs. 30 to 40 Million a year, whereas, Kenyan Seed Company is benefiting from the commercialization of these varieties. A challenge that these research institutions have to grapple with is the dilemma between their mandate-research for public benefit, and the need and the opportunity availed by the possibility of utilizing IPRs for generating income for sustainability.

4 CHAPTER FOUR

CRITICAL ANALYSIS OF STUDY FINDINGS

Introduction

This chapter analyses the study findings captured in chapter three. The chapter seeks to interpret meanings and implications of the emerging issues on intellectual property in public research institutions in Kenya. By closely examining the findings in chapter two, the chapter tries to find out if indeed the public institutions in Kenya have the capacity to claim and exploit the benefits of IPR that accrues from their research activities; if in deed the institutions are over reliant on support from donors and collaborators and the implication this has on their ability to effectively claim IPR and accruing benefits; and finally if the innovations that are protectable in deed have higher returns and greater social and economic gains.

4.1 INSTITUTIONAL CAPACITY

In this section, we examine the hypothesis that investment and institutional capacity influence the rate of innovations, the nature of protection, and the resulting returns. The study found out that other than KIRDI, which has most of its centers located in Nairobi (five service centers and three core research programs), both KARI and KEMRI are spread all over the country, in response to the varied ecological demands of their researches. KARI has twenty two centers and fourteen sub-centers to cater for ecological diversity, importance of factor of production, importance of commodity, and special circumstances in areas necessary for exploring future potentials in specific geographic regions. KEMRI currently supports a network of ten research centers in response to preponderance of diseases by regions. Due to this geographical spread the study concludes that the research institutions have strived to accrue greater social needs and economic gains for the people of Kenya.

However, the trend in human resource pointed out that all the three institutions studied were found to be bottom heavy. In KARI the total human resource at the time of the

study stood at 3,536. The significant finding here was that a whopping 78.1% of the personnel were not directly involved in research, while 21.9% were researchers (12.1%), technologists and technicians (9.8%). KEMRI had 1,535 personnel, 50% of whom were researchers and/or scientists. KIRDI had 228 personnel with 12.7% researchers, 35.6% technicians and technologist and 51.7% in administration and support. The effect of this bottom heavy human resource infrastructure on research is that more money is spent on recurrent expenditure in terms of paying salaries and other remunerations of none core workers at the expense of R&D. Indeed, a comparison between development and recurrent expenditure reveal that the later takes the lion's share compared to the former. This is a negation of the raison-de-etre of the research institutions-their core mandate is to conduct research and not to be reservoirs of jobs for the jobless.

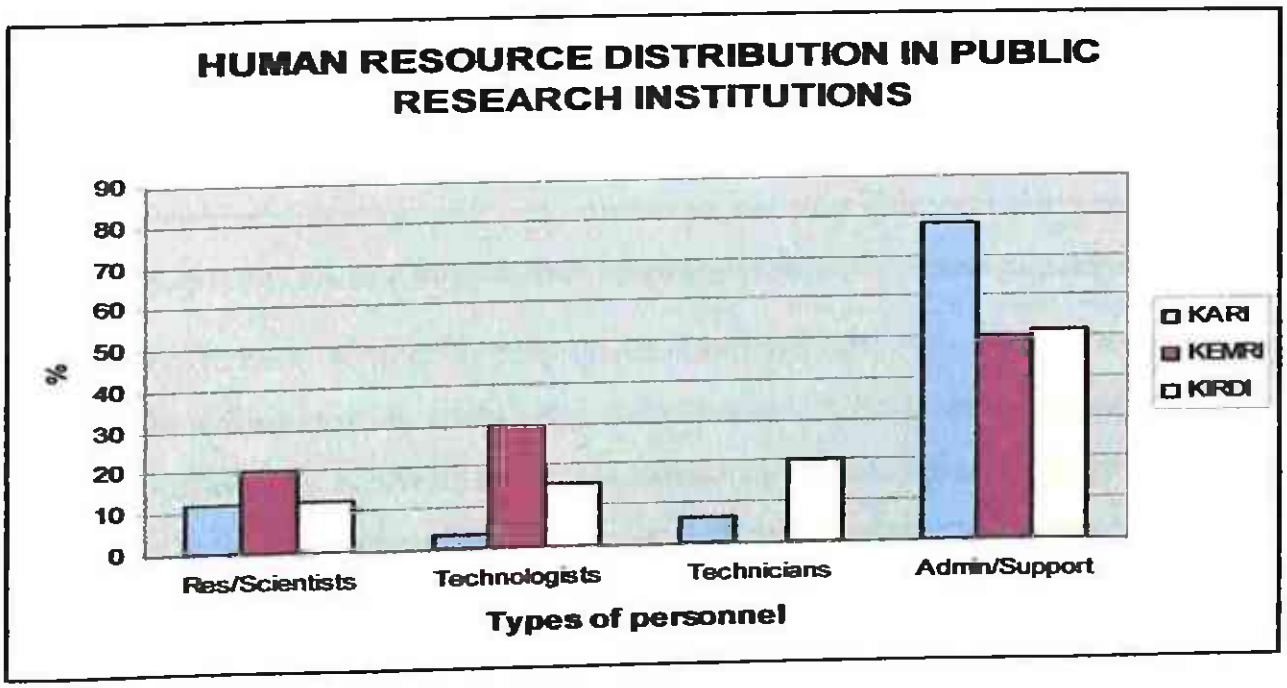

Chart 11: Human Resource Distribution at KARI, KEMRI and KIRDI

4.2 INVESTMENT AND RETURNS

The influence of investment on research and innovations was examined with the amount of budgetary allocation to the Institutions by the Government and the collaborating agencies. As stated above, it was apparent that the three institutions were allocated most of the money by the government for recurrent expenditure. Between 1992 and 2004 the government allocated the recurrent expenditure to the three research institutions as

follows; KARI was allocated approximately Kshs.8.3 billion, KEMRI was approximately Kshs.4.09 billion, and KIRDI was approximately Kshs.1.3 billion. During the same period KARI invested approximately Kshs.3.4 billion in development expenditure during the period 1993 and 2004. KEMRI invested approximately Kshs.699 million during the same period, while KIRDI invested approximately Kshs.137 million.

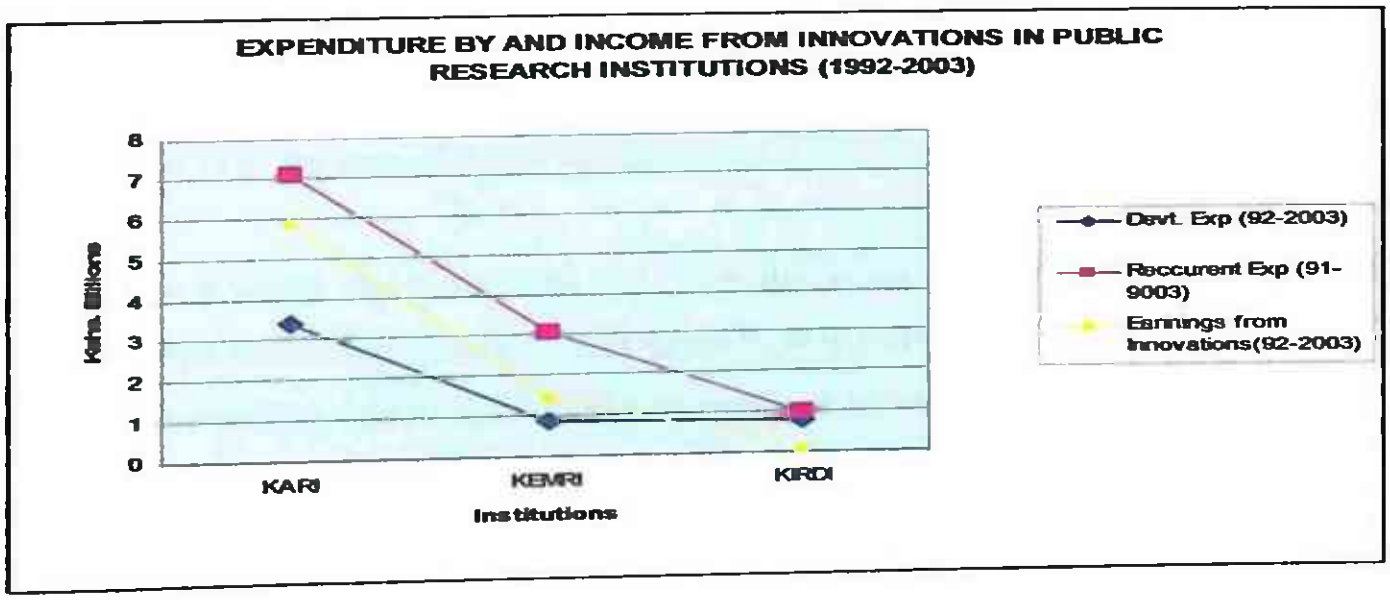

Chart 12: Expenditures and income from innovations in public research institutions

The study was able to accrue data on income and earnings by the three institutions from some of their innovations within the same period. KARI earned most (approximately 5.8 billion) followed by KEMRI (app. 1.4 billion) and lastly KIRDI (app.137 million). From the above it is very clear that there is a direct positive correlation between level of investment in R&D and the benefits that accrue from the innovations that ensue.

4.3 COLLABORATION

As earlier indicated, a substantial presence of collaborating agencies was noted at the research institutions. During this study, it was observed that KEMRI maintained twenty-six (26) collaborating agencies, KARI twenty one (21) and KIRDI twenty (20). This finding validates our initial hypothesis that public research institutions in Kenya rely greatly on support from and collaborators and the implication this has on their ability to effectively claim IPR and accruing benefits.

This study observes that these agencies provided up to 60 % of the research funds and provided substantial technical assistance through researchers and/or technologists. The research institutions' infrastructure was also largely attributed to donor support. The study notes that without this support the level of R&D in the country would be lower. This dependence on collaborators translates into these organizations having less say over ownership of the final products (innovations/processes) vis-à-vis the collaborators. It was observed that some of the IP that accrues from collaboration are not claimed directly by the Kenyan scientists as it is viewed as public knowledge, while most are claimed by the collaborators as in the case of KARI for instance.

The fact that KEMRI was not able to fully own the patent for KEMRON and the initial tussle of patent ownership between it and its partners is a clear indicator of the difficulties faced in IP protection within a collaborative environment. In KARI, the study found out that some of the IP that accrues from collaborations are not claimed directly by the Kenyan scientists as it is viewed as public knowledge. Even when collaborating with states organizations and multi-nationals like Kenya Seed Company, Pyrethrum Board of Kenya, Kenya Sugar Board and East African Breweries to develop high yielding varieties of commercial crops, it is these organizations that end up owning the IPRs for the innovations.

In KARI eighty-three (83) innovations that applied for PBR protection were innovated in research collaboration with other organizations. Again, of the total one hundred and fourteen (114) PBR applications, only twenty-six (26) have been forwarded to the Ministry of Agriculture for gazzetment, mainly because KARI was unable to pay processing fees. The same trend was noted in KIRDI that reported forty-six (46) innovations that it used largely to assist various companies, small and medium enterprises that in turn, own the subsequent innovations and carry out the efforts related to protections simply because its principle collaborator, UNIDO has a policy requirement that ensuing innovations from researches carried out under its assistance are treated as public property for public welfare, hence prohibiting the efforts of the scientists to accrue any benefit from it. Yet the same processes are taken up and protected elsewhere- e.g.

fish leather processing has been taken up by Uganda, Tanzania and Italy. It has been noted that most applicants for IPR protection are financially incapacitated and cannot pay the obligatory fees for the grant of IPR certificates. Universities and individual breeders are not spared. Under such circumstances, enterprising collaborators take advantage to claim the rights and the monetary advantages that accrue from it, simply because the research organization is not able to do so. Most often than not, it is the foreign collaborators or companies that seek to purchase the right.

4.4 RESEARCH AND INNOVATIONS IN THE RESEARCH INSTITUTIONS

The study found that the three institutions have done varied amount of research and reported innovations. While KARI had reported the highest number of researches and innovations six hundred and twenty-seven (627); KEMRI had reported less eighty (80) and KIRDI reported only forty-six (46). The fact that KARI got the highest amount of funding, employed the highest number of personnel could be partly responsible for this. Again, Kenya is a developing country that depends largely on agriculture (the sector employs more than half the population) also implies that the demand for new innovations in the sector is high, especially from the private sector. Of the researches and innovations reported by KARI, 72.57% were in the field of agriculture, while only 19.1 were reported in livestock health, production and management. Only 8.29% were reported in soil and water resource management. The above implication imply that research on food crop varieties recorded the highest number of innovations two hundred (200) and food crop management innovations recorded one hundred and nineteen (119) predominate the research and innovation in KARI.

In KEMRI, even though research and innovation in treatment of malaria dominated, the organization also ventured on other important inventions for treatment of diseases like HIV/AIDS, tuberculosis, hepatitis, leprosy among others. Medical research is known world-wide to be very expensive and cautious as experiment with human drugs must always pass the ethics muster. This could account for the disparity in quantities of inventions and innovations compared to those done by KARI. Another finding worth

noting is that some of the researched done in KEMRI were conducted in conjunction with pharmaceutical companies with interest in accruing benefits from the discoveries. Malaria is number one killer in tropical countries such that whoever gets efficacious drug for it in the tropics is sure to reap a lot of profit. This could therefore also be said to affect the number of researches by the organization-pharmaceutical companies only collaborate where they are sure to maximize their profits. Further, it is expected that at the end of such joint ventures, the fund donor walk away with the IP right, leaving the company where it found it as the proceeds cannot be ploughed back into other diseases of poverty, that are prevalent but less profitable to the multinational pharmaceutical companies like Wellcome, GlxoSmithKline Plc, TDR and WRP.

The meager research and innovations reported at KIRDI forty-six (46) between 1990 and 2004 is not only a reflection of the meager resources the organization got from the government, but it is also a reminder that research innovations in manufacturing industry is spurred to a large extent by existence of such industries as a precondition, something that Kenya is still grappling with. The fact that its outreach is mainly in Nairobi further confirm that its vibrancy is closely correlated to existence of manufacturing industry.

It is important to note that with the exception of KARI that had began the process of centralizing its R&D data, KEMRI and KIRDI did not have centralized data bases and it is assumed that there may have been more innovations that were not captured by the study. It may be no wonder that only a few officials know of the innovations and inventions that accrues from their R&D. This lack of appropriate and easily retrievable record keeping hampers research and any useful studies that may be beneficial to the institutions.

4.5 PROTECTION OF INNOVATIONS IN THE RESEARCH INSTITUTIONS

From the study findings it is clear that despite the fact that different institutions, both public, private and foreign have made a notable stride in discovering new innovations in Kenya in terms of products and processes, the bulk of these innovations have gone unpatented/unregistered in the names of the innovating institutions, hence they have not been able to accrue the benefit that such innovations bring. According to KIPI,[155] only 25.1% of cases of national patent application were successfully granted patents while in PCT national phase it was only 27%. National industrial design applications have been more promising with 58.6% of the applications granted as shown in the chart below.

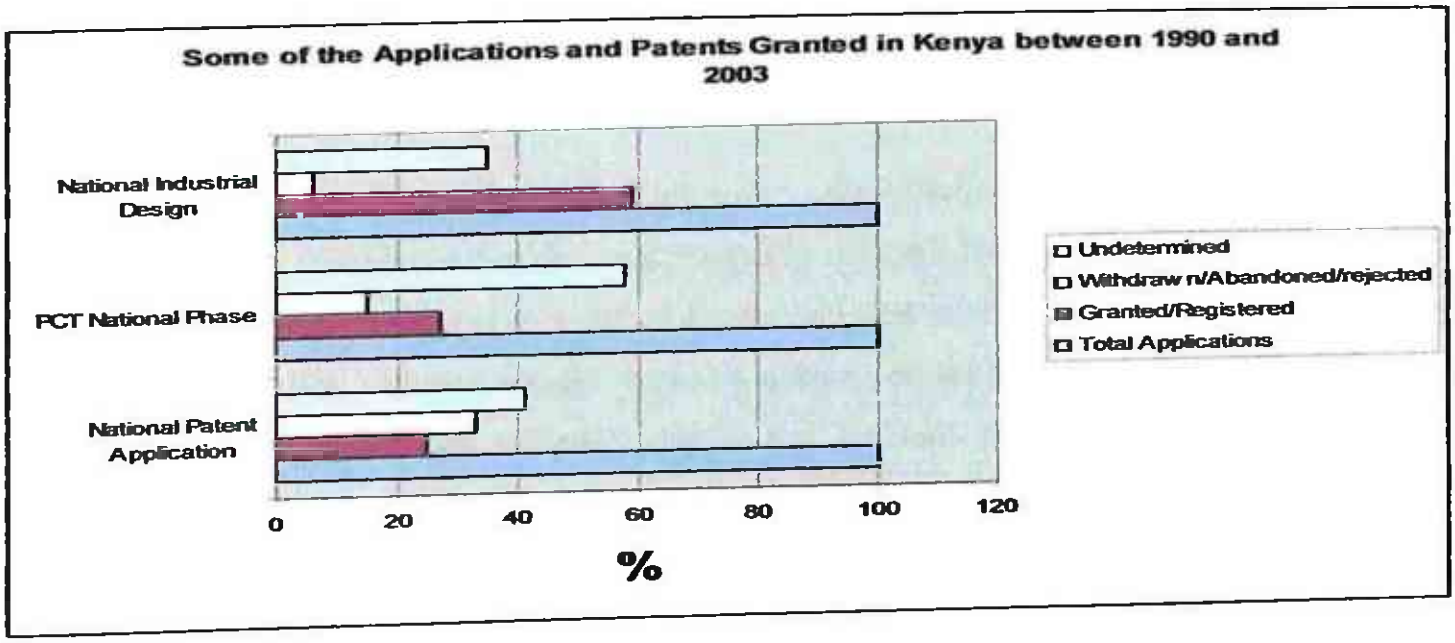

Chart 13: Applications and patent grants in Kenya between 1990 and 2003

Again, out of the total 3,920 patents under CAP 509 total registrations, only 3.4% are in force, and 96.6% are reported to have expired. Even the growth of trade mark processing in Kenya from the 1990s has been low, though steady.[156] The registration of trade marks in Kenya increased by 897 from 160 in 1992, to 1,057 in the year 2002. This expansion in registration of trade mark was attributed to increase in awareness in Kenya after the legal

[155] KIPI Patent Registry Report 19th August, 2003.
[156] KIPI, 2003

reforms instituted by the government between 1990 and 2001 (Industrial Property Act. 1990 and the New Industrial Property Act 2001). Again, an examination of protection under the Plant Breeders' Rights[157] reveals that the sector is dominated by foreign breeders (326 applications) and foreign firms (56.4%) whose interest may not necessarily be to benefit the local population as they concentrate on horticulture and mostly on ornamental crops.

Judging from the findings from the three research institutions, it is apparent that intellectual property rights protection was never in the founder's instructor's manual at the outset. The acts of parliament that established the three institutions were silent on how to handle the wealth of knowledge that would accrue from the researches, particularly in terms of ownership of innovations and products.

At KARI and KIRDI the study found out that institutionalizing IPR was at a formative stage, having just appointed Intellectual Properly officers to deal with IPR issues. Even IPR policies in the institutions are yet to be formulated according to the key informants from KARI/KEMRI. The findings were positive at KEMRI in this regard, as it established that there is an IP policy in place to deal with protection of accruing innovations, and an IP committee composed of selected scientists representing all their R&D centres, however, they are still dependent largely on KIPI for this work. It was reported that an office for IPR protection, headed by an assistant director for production and marketing had been initiated. This shows overlap of responsibilities as there should be a dedicated officer to handle IP matters. A majority of the scientists in the institute were also yet to be sensitized on the importance and the procedures for protection of intellectual property rights. At KIRDI, protection of IP is in the hands of foreigners and private entrepreneurs who have owned IPR rights of the products developed at this institution.

The above scenario clearly point out that a large amount of innovations in Kenyan research institutions go unregistered, which implies lots of wasted opportunities. The

[157] KEPHIS, 2003

reasons for the inordinately large proportion of unregistered innovations are largely due to lack of capacity to follow through with the process of invention, development and commercialization, and the possibility of non responsive systems either in terms of efficiency and or legislative capacity of the relevant agencies. Protection of IPR by the research institutions is further complicated in cases of collaboration with external partners. As the case of UNIDO and KIRDI shows, the partner often expose such innovations to theft when they insist that the research institution cannot claim ownership to the accruing innovations, while in other cases like between KEMRI and partners, the claim may be staked by both parties, hence bogging the process.

Another touchy issue that emerged is reconciling the mandate of the public research institutions of promoting self sufficiency and welfare of Kenyan citizenry in terms of food, health and vision for industrial development against the fact that protection of intellectual property right entails payment by whocver uses such innovation. This is more so, when we take into consideration the level of poverty within the populace, and the fact that these institutions are run using the citizen's taxes. The institutions are thus in dilemma of whether to protect their innovations and harm the populace whose welfare is the main reason behind their setting up or to release them for free.

The study also noted that protection of intellectual property rights is an expensive undertaking that require adequate funding. The institutions that safeguard protection of the rights require that registration and periodic fees are paid for recognition and safeguard of ownership. A study of the three institutions shows that they have not managed to maintain this regime. KEMRI lost patent ownership of KEMRON because it could not renew payment of annual fees for patent protection by ARIPO, a situation on which it transfers the blame to the government for not having provided it with funds. At KARI, a lot of innovations were released for use by public and private users because the institute could not afford registration fees to the relevant registering organization resulting into very low plant breeder's registration. These institutions, it was noted, had not undertaken an IP audit due to the high cost associated with it, thus, the institutions do not have a clear

indication of their innovations that can be protected, leading to wastage, and loss of opportunities.

All the three institutions under study blamed the government for not providing substantive investment to the institutions for IPR protection. Further, they pointed out that the protect-able innovations are not given the preference in terms of local usage as would have been expected. The case in point is that of KEMRON which was given scant recognition in Kenya by the government against other imported products. Such lost opportunities are readily taken up by other more developed countries. KEMRON was taken up by a Swiss company and is now sold worldwide, including Kenya, at a profit. Similarly, the fish skin technology developed by KIRDI is now being used in Uganda and Italy at a profit without the institution staking any claim.

The institutions also pointed out that the government's yearly budgetary allocation to research and development is negligible thus hindering development of innovations and their protections in the country. Development policy papers are also silent on the role of research and development and its subsequent contribution to industrialization and self sustainability.

4.6 BENEFITS FROM PROTECT-ABLE INNOVATIONS

From the findings of the study, it is obvious that the protect-able innovations made by the three research institutions are highly beneficial to both the institutions, individual users and the society at large. At KARI, the strides made through biotechnology have offered opportunities to reduce production constraints in both animal husbandry and plant breeding in terms of production of pest, drought and disease resistant/tolerant crop varieties, vaccines for livestock and improvement in soil types. These improvements have led to better food security, improved income generation by farmers, improved employment and marked poverty reduction through the agricultural sector especially the horticultural sector.

Some of the particular benefits that can be attributed to KARI, as noted above in the findings include the tissue culture banana variety that led to 30% reduction in post-harvest loss by farmers leading to improved quality of fruits hence good price and higher income for the farmers; provision of improved passion fruits seedlings variety that averted the 80% loss by farmers and led to improved yields; improvement in potato variety through introduction of high yielding varieties like Kenya Mavuno, Kenya Karibu, Kenya Sifa, Kenya Faulu, Tigoni and Asante varieties have ensured high yields and easier and affordable to grow potato varieties. In the field of veterinary medicine KARI developed East Coast Fever Vaccine "Infection and Treatment Method" (ITM) that has led to management of East Coast Fever not only in Kenya but in other East African countries. This venture has accrued KARI a lot of income as can be seen from the study findings above. KARI has also sold other vaccines and diagnostic kits. That it has monopoly over eastern and horn of Africa is a pointer to the potential it has if all its innovations were to be protected.

Protect-able innovations at KEMRI have also shown tremendous promise. To start with, the sale of KEMRI HELPCELL II to health practitioners yielded over Kshs. 5 million in the 2002/3 financial year alone apart from what the institute donated to other health practitioners who could not afford the kits. There have also been innovations in treatment of HIV/AIDS, malaria, tuberculosis and leprosy. It is important to note that these are very important diseases in Kenya and innovation by KEMRI has gone a long way to cut the cost of managing them.

The industrial innovations reported by KIRDI in areas like leather processing, leather fat liquoring products, production of ceramic glasses, laboratory bench power supply, acetic acid from molasses and wood and water based ink have also been appreciated especially by the Jua Kali sector, which is the backbone of manufacturing industry in Kenya even though complaints about over-centralization of their activities have been raised.

In conclusion, the study points out that the man power structure in the research institutions is bottom heavy putting a lot of strain on the scarce resources. Most of the resources are directed to recurrent expenditure at the expense of the core business-research. The collaborations, though providing a lifeline to the institutions are also a hindrance when it comes to claiming IPR as the collaborators at times stake similar claims as the research institutions.

Protection of innovations is therefore still poor as they are at the formative stages of institutionalizing protection of IPR. However the potential of harnessing financial returns from protection of innovations by the research institutions is very high as can be seen from the tremendous benefits already accruing from what they have done so far. It is also apparent that the institutions, especially KARI, KEMRI and KIRDI have taken cognizance of TRIPS treaty and its domestication in Kenyan laws and have hence put up structures to comply with them, albeit narrowly.

5 CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY

The objectives of this study were to identify innovations and inventions in three public research institutions between 1990 and 2004, to determine the IPR status of the identified innovations and inventions and to examine the IPR strategies in these institutions and their achievements in order to ascertain the impacts of adoption/domestication of TRIPS agreement in public sector research, and development policies.

The hypotheses adopted at the beginning of the study were that the public research institutions in Kenya lack the capacity to implement and benefit from the intellectual property rights as contained in the Trade Related Aspects of Intellectual Property Rights agreement; the public research institutions in Kenya are over reliant on support from donors and collaborators and can therefore not effectively claim IPR and accruing benefits from the inventions and innovations and that; the innovations that are protected will have higher returns and greater social and economic gains as espoused in the TRIPS agreement.

The study findings indicate that the selected research institutions have reported a substantial number of innovations that contribute directly to the economy when applied. The study concurs with the applied theory of entrepreneurship development in its observation that institutional capacity (availability of entrepreneurs) and protection (IPR) influence the rate and level of R&D. However, public research institutions operate according to government policy and therefore may not necessarily follow with the theory's monopolistic proposition as the R&D that accrues is immediately transferred and applied in various sectors of the economy.

5.2 CONCLUSIONS

This study has reviewed the innovations and inventions in the three research institutions and found out that that there is some attempt at implementing IP protection in all of the institutions with mild success in both KARI and KEMRI but low implementation at KIRDI. The institutions (with exception of KEMRI) are yet to have coherent IP policies and strategies to guide and direct them in matters of intellectual policy leading to continued loss of benefits that should have accrued from such IPRs. Lack of funds for research in the three institutions directed at R&D means there is not much IP to protect, and the fact that many of the R&D are done in collaboration with external partners with vested interest is an hindrance to the institutions claiming the IPR benefits. These external partners also tend to control the directions that the R&D takes, which may not necessarily be in the interest of the mandate of these institutions.

None of the institutions have a dedicated IP protection budget, a challenge that is worsened by the long and expensive procedure for applying for protection with the national institutions charged with IPR registration, including the regional and the international IP registration offices. Another challenge for the institutions with regard to claiming IPR from their innovations is the dilemma between their mandate as public institutions and the profit oriented nature of IPR claims. The man power structure in the research institutions is bottom heavy, while most of the resources are directed at recurrent expenditure. Protection of innovations are still poor as the institutions are at the formative stages of institutionalizing protection of IPR & developing IP policies to govern their R&D activities. However the potential of harnessing financial returns from protection of innovations by the research institutions is very high as can be seen from the tremendous benefits already accruing from what they have done so far.

From the study it is apparent that domestication of TRIPS agreement at KARI, while heralding increase in profits to private seed companies and foreign collaborators may be counterproductive for the local small scale farmers who depend heavily on the certified seeds that KARI produce, as patents may make seeds more expensive for them. The locals may also not gain much from some of the R&D conducted in collaboration with

foreign partners as their interests tend to be dictated by markets in their home countries and not local concerns, hence negating the much hyped technology transfer touted as a major benefit of TRIPS to agriculture in developing countries.

At KEMRI, there are signs that domestication of TRIPS is underway in terms of putting up infrastructures. The institution has shown that R&D and IP protection can be of benefit to research institution but the flipside is that domestication of TRIPS has tended to be a costly affair to Kenya like other developing countries. Medical research institutions like KEMRI still do not have the requisite capacity to utilize the advantages that TRIPS allow in the medical arena like compulsory licensing and manufacturing of generic drugs in terms of provision of advise to critical stakeholders and also manufacturing of the drugs perhaps due to lack of capacity. Kenya has therefore suffered the consequences of bearing the expenses of purchasing very expensive drugs from patent holders.

At KIRDI, the dearth of innovation and invention in areas of new technology is a clear indication that the much hyped technology transfers that was to flow into developing countries with the signing of the TRIPS agreement was largely a ploy to deny them access to these technologies. It is apparent though that the attention of KIRDI is to be of service to the local entrepreneurs and thus develop technologies that serve the needs of these groups.

However, the study also observed that research output and IPR protection are high where there are substantial levels of investment and institutional capacity as shown in KARI and KEMRI. These levels are directly affected by collaboration. In this regard, it can be concluded that Article 7 of the TRIPS Agreement may be appropriate for Kenya but a lot needs to be done to ensure that the adverse effects of TRIPS are mitigated. It is important to observe that there was a difficultly in ascertaining the impact of most of the R&D and the IP protected innovations as the available data is not base line and therefore difficult to quantify.

Implementation of the TRIPS Agreement, particularly Article 7, presents opportunity to economically develop through technological innovations if implemented carefully, such that the provisions that the developing countries fought for during the negotiations are used.

The study findings indicate that Kenya has tremendous potential to technologically advance using its public research institutions, to meet economic growth targets. There is need, therefore, for the government to dedicate appropriate resources to R&D and develop and implement policies that are aimed towards R&D and IP protection for the development of research institutions to meet technological advancement, and capacity to operate and benefit through the application and implementation of the TRIPS Agreement and other related policies and undertakings.

5.3 RECOMMENDATIONS

The following are the recommendations drawn from the study findings:

- There should be concerted awareness creation on importance of IPR both within the research institutions and among the public in order to stem the losses that have been witnessed in the institutions and beyond, to foreigners.
- The research institutions should improve on their record keeping of research, innovations and resulting products both the research institutions, KIPI, and the government need to give considerable attention to the procedures and systems of record management through which the country can have up to date information on innovations, protection and returns.
- There is need to develop a national system for classification of innovations to protect strategic innovations from exposure to competitors.
- There should be provision of incentives to scientists and/or technologists to motivate them to be more dedicated and innovative.
- Policies that support and promote innovations and research initiatives should be developed and adopted by government, taking into account commercialization and industry linkages of R&D in public research institutions.

- Processing of applications at KIPI should be shortened and simplified e.g. application and registration.
- The research institutions should institutionalize IP policies and practices that have so far been drafted.
- Appropriate technical assistance should be provided to the institutions for completion and implementation of their IP policies.
- Attention in the research institutions should be given to budgeting processes.
- Reforms should be undertaken to exploit entrepreneurship skills to facilitate self sustaining operations in terms of production costs and marketing.
- Adequate resources should be directed to research, innovation and protection and reduce on operation and maintenance.
- The human resource in the institution should be rationalized with fewer personnel on the support cadre than in research and technology. Efforts should be made to increase the levels of scientists, technologists and technical assistants particularly in KARI and KIRDI.
- Appropriate policies should be developed by the institutions to attract collaboration for purposes of technology transfer and pooling of resources, however, care needs to be taken to guard against loss of IP ownership of ensuing R&D.
- Kenya should take advantage of provisions within the TRIPS agreement to ensure they are optimized.
- Kenya should treat the technical assistance got from the MNCs with a lot of care as they have, many a times, vested interests which are at times not in consonance with Kenyan public interest.
- The study recommends that detailed studies be undertaken on specific technological advancements to determine exact benefits/contributions of R&D, and to establish their role in economic development. Furthermore, detailed studies on adoption of global and national policy undertakings on R&D, IPR and other related policies should be studied to establish their effects on the economy and factors that facilitate and/or hinder their adoption and benefits.

APPENDICES

APPENDIX 1: KARI RESEARCH CENTRES

Table 25: KARI Research Centres and Areas of Specialization

No.	Research Centre	Primary Specialization
1.	Kenya Agricultural Research Institute	Headquarter, management and central data base
2.	Alupe Agricultural Research Sub Centre, Busia	
3.	Embu Regional Research Centre	Seed Maize varieties for medium altitude; Advisory, consultancy and training on crop and livestock production.
4.	Garissa Regional Research Centre	
5.	Kakamega Regional Research Centre	Maize varieties resistant to striga weeds; Improved Sweet potato varieties; Cassava varieties resistant to virus diseases; Fodder grasses; Agrochemical efficacy trials; Crop variety performance trials; Advisory and training services in crop and livestock production.
6.	Katumani National Dry land Research Centre, Machakos	Maize varieties for low rainfall areas; Sorghum varieties, Pearl millet, Beans, Pigeon peas, Cowpeas, green grams, pigeon peas etcetera. Advisory, consultancy and training on dry land crop production; Laboratory analytical services.
7.	Kiboko National Range Research Centre	Livestock, Horticulture, Honey.
8.	Kibos Cotton Research Sub Centre, Kisumu	Cotton.
9.	Kibos National Sugar Research Centre, Kisumu	Sugar.
10.	Kisii Regional Research Centre, Kisii	Banana planting materials; Advisory, consultancy and training in crop and livestock husbandry.
11.	Kitale National Agricultural Research Centre	Seed Maize varieties; Agrochemical efficacy testing for maize, wheat, beans and horticultural crops; Advisory services on crop breeding and production.
12.	Lanet Beef Research Sub Centre	
13.	Lanet Seed Quality Research Centre	
14.	Marsabit National Arid Lands Research Centre	
15.	Molo National Pyrethrum Research Sub Centre	
16.	Mariakani Animal Production Research Sub Centre	
17.	Matuga Agricultural Research Centre	
18.	Mtwapa Regional Research Centre	Maize varieties suitable for low land coastal areas; Cassavas, Sweat potatoes, Fodder crops, Dairy cattle, Mango varieties seedlings, Citrus varieties seedlings, Coconuts, Cashew nut varieties, Milk; Advisory, consultancy and training on production of above products.
19.	Msabaha Agricultural Research Sub Centre	
20.	Muguga National Agricultural Research Centre	Seed maize varieties- resistant to maize streak virus, Dairy cow heifers- Friesians; Integrated pest control technologies, Soil analytical services Social economics research Contract research.
21.	Muguga National Vet Research Centre	Vaccines; Referral centre for animal diseases diagnosis; Veterinary services.
22.	National Agricultural Research Laboratories	Small scale Drip irrigation system. Laboratory Analytical Services, Land Resource use suitability survey, Irrigation and Drainage survey, and design and installation supervision.
23.	Naivasha National Animal Husbandry Research Centre	Sahiwal dual purpose cattle; Sahiwal/ Friesian cross dairy cattle; Friesian dairy cattle heifers; Kenya Dual purpose goat; Indigenous month old chicken; Broiler chicken; Eggs; and are experts in cattle, pigs, poultry, goat nutrition and management.
24.	Njoro National Breeding Research Centre	Wheat varieties and seeds, Oil crop varieties and seeds.
25.	Mwea Tabere National Fibre Research Centre	
26.	Perkera Agricultural Research Sub Centre	
27.	Ol Joro Orok Agricultural Research Sub Centre	
28.	Tigoni National Potato Research Centre	Potato seed varieties; Advisory, consultancy and training on all aspects of potato seed and commercial crop Production.
29.	Thika National Horticultural Research Centre	Tissue culture banana planting materials; Fruit tree seedlings; Cut flowers; Advisory, consultancy and training services on horticulture production; Post harvest handling and processing of horticultural produce.
30.	Buchuma Range Research Sub Centre	
31.	Transmara Veterinary Research Sub Centre	

APPENDIX 2: KEMRI RESEARCH CENTRES

Table 26: KEMRI Research Centres and Areas of Specialization

No.	CENTRE	MANDATE
1	Centre for Biotechnology Research and Development (CBRD) *Location: KEMRI Headquarters Complex, Nairobi*	a) Development of biotechnological innovations especially for diagnostic tools, vaccines and biological materials. b) Immunology and immunopathology of infectious diseases. c) Immunology of HIV/AIDS. d) Specialized services in immunology and immunodiagnoses, e.g. tissue typing, HIV/AIDS. e) Quality assessment in clinical histopathology. f) Vaccine and drug trials in animal models. g) *In vitro* cultivation of malaria and leishmania parasites for experimental purposes. h) Colonization of mosquitoes and sandflies for experimentation. i) Formulation of biosafety guidelines. j) Co-ordination of experimental research and management of animal houses
2	Centre for Clinical Research (CCR) *Location: KEMRI Headquarters Complex, Nairobi*	a) Clinical trials. b) Leishmaniasis: epidemiology, field and laboratory diagnosis, drug trials. c) Schistosomiasis: patient management, diagnostic tools, field trials for control. d) Hydatid disease: management and drug trials. e) Malaria: pathophysiology, drug sensitivity (human) including surveillance, drug trials, field control strategies (human-parasites), diagnosis, vaccine trials;interaction between malaria and HIV infections. f) HIV/AIDS/STI. g) Human reproduction and population. h) Cardiovascular and renal diseases. i) Oncology. j) Oral health: epidemiology and control of dental disease
3	Centre for Geographic Medicine Research - Coast (CGMRC) *Location: All the units at the Coast (Malindi, Kilifi, Kwale & Taveta Director's office at Kilifi.*	a) Malaria and other parasitic diseases. b) HIV/AIDS/STI. c) Health systems research. d) Maternal/Child Health and Reproductive health.
4	Centre for Leprosy and other Skin Diseases Research (CLSDR) *Location: Alupe, Busia District, Western Kenya*	a) Leprosy: epidemiology,pathology, diagnosis, management, control strategies, immnnology, drug sensitivity, rehabilitation, vaccine and drug trials, psycho-sociological studies and animal experimental studies. . b) Skin diseases: epidemiology, pathology, diagnosis, drug trials, control strategies, immunology and drug sensitivity. c) Molecular epidemiology of agents of dermatological conditions. d) Studies on HIV/AIDS/STI.
5	Centre for Microbiology Research *Location: Kenyatta National Hospital Complex, Nairobi. Some laboratories are also at the KEMRI Headquarters complex, Nairobi*	a) Diarrhoea: i) Cholera - epidemiology, characterisation, drug sensitivity. ii) Other microbiological agents (excluding viruses). b) Sexually transmitted infections: i) Aetiology, prevalence, epidemiology, control strategies; ii) HIV/AIDS - opportunistic infections and drug trials. c) Other bacterial and mycotic infections: aetiology, prevalence, epidemiology, control strategies. d) Epidemiology of nosocomial infections: aetiology and control strategies. e) Antimicrobial monitoring and surveillance including molecular characterisation. f) Biology of protozoal and helminthic infections: aetiology, epidemiology,

			immunology, control strategies.
		g)	Schistosomiasis: epidemiology, vectors, control strategies.
		h)	Filariasis: aetiology, epidemiology, diagnosis, control, immunology.
6	Centre for Public Health Research (CPHR) *Location: Kenyatta National Hospital complex, Nairobi.*	a)	Health systems research: Health services research including community-based services, health policy analysis, health economics and planning system development.
		b)	Applied human nutrition: epidemiology, interventional trials, nutrition biochemistry.
		c)	Child health: early childhood and development, school health programmes.
		d)	Population studies: demography and fertility studies.
		e)	Behavioural studies: medical sociology, health anthropology, health education.
		f)	Training in epidemiology, biostatistics and computer applications.
7	Centre for Respiratory Diseases Research (CRDR) *Location: Kenyatta National Hospital complex, Nairobi*	a)	Tuberculosis: epidemiology; case finding and holding; immunisation; pharmacotherapy of TB - pharmacoepidemiology of drug resistance; TB in HIV infections.
		b)	Non-TB respiratory diseases - high priority pathologies e.g bronchial asthma; industrial respiratory implications; acute respiratory infections.
		c)	Lung function.
		d)	Immunology of TB and allergic conditions.
		e)	Environmental and occupational health.
8	Centre for Traditional Medicine and Drug Research (CTMDR) *Location: KEMRI Headquarters complex, Nairobi*	a)	Traditional medicines: Rationalization of traditional medicines in collaboration with traditional healers; evaluation of plant drugs using medicinal phytochemistry, pharmacology and toxicology; formulation of herbal remedies; antischistosomal agents of plant origin.
		b)	Socio-cultural and anthropological aspects of traditional medicine.
		c)	Drugs: Experimental pharmacology and toxicology; biopharmaceutics and relevant pharmacokinetics; clinical trials.
		d)	Agents for the control and management of HIV/AIDS/STI.
		e)	Quality assurance of drugs: quality control and surveillance.
9	Centre for Vector Biology and Control Research CVBCR) *Location: Kisumu, Western Kenya*	a)	Vectors: The biology of vectors, their vectorial capacities and control strategies based on biological, chemical and genetic approaches.
		b)	Vectors of bacterial and viral diseases.
		c)	HIV/AIDS/STI.
		d)	Malaria vaccine field trials, molecular biology of parasites and socio-cultural issues in vector control.
10	Centre for Virus Research (CVR) *Location: KEMRI Headquarters complex, Nairobi*	a)	Acute haemorrhagic fevers: epidemiology, surveillance and control.
		b)	Rabies: diagnosis, management and vaccine evaluation.
		c)	ARI: epidemiology, diagnosis, aetiology, management and control.
		d)	Viral diarrhoea: studies on aetiology, epidemiology, management and control; vaccine trials and molecular characterisation.
		e)	Viral hepatitis: epidemology, aetiology, diagnosis and control.
		f)	KEPI: vaccine potency evaluation; polio eradication.
		g)	HIV/AIDS/STI: diagnosis, molecular epidemiology, development of HIV reagents, anti-HIV drug studies and establishment of P3 Biosafety laboratories.
		h)	Vaccine quality control and manufacture.
		i)	Development, production and trials of vaccines and diagnostic agents; viral diagnostics; molecular techniques.

APPENDIX 3: RESEARCH AND INNOVATIONS AT KARI

Table 27: Selected Crop Varieties Released by KARI between 1990 and 2005

Crop	Variety released
Bread wheat	Njoro-BW1, Njoro-BW2, Mbega, Duma, Ngamia, Chozi , K. Heroe, K. Yombi, Kwale, Kenya Tumbili, Kenya Nyumbu, Kenya Paa, Kenya Kulungu, Kenya Kudu, K. Kima, Kenya Ngiri, Kenya Zabadi, Mamba, Leopard, Kenya Nungu, Pasa, Kenya Popo, Kenya Tembo, Kenya Fahari, Kwale, Kenya Chiriku, Kenya Nyangumi
Maize	Muguga-1, Muguga -2, KH600-15A, KH600-16ª, KH633A, KH634A, KH634A, EMCOa, OPV-EMCOb, OPV1, OPV2, KH600-11D, KSTP94, Coast Composite, Dryland Composite 1, H622, H625, H632, H614D, H511, H626, H611C, H612D, H613D, H627, Katumani Composite B
Pigeon peas	Kat/Mbaazi -1, MBAAZI -2 (ICEAP 00040), Kat/PP 60/8, 26. Kat/PP 777
Lablab Beans	Kat/DL-1, Kat/ Dl-2
Mung Beans	Kat/MB -22, Kat/MB-26
Cowpeas	Machakos 66, K 80, KVU – 19, 34. KVU 419
Dry Beans	Kat/Bean 1 (Kathika), Kat/Bean 9, Kat – x - 16, Kat –x – 56, Kat – x – 69, GLP 2 (Rose Coco), GLP24 Canadian Wonder, GLP 1004 (Mwezi Moja), GLP 1127 (Mwezi Moja), GLP 92 Mwitemania
Finger-millet	Kat/FM-1
Pearl Millet	Kat/PM-1, Kat/PM-2, ICMV 221 (Kam/PM 3)
Sorghum	Serena, KARI/Mtanaa-1, Gaddam, E1291, E6518, IS76, 2KX17
Cassava	KME 1, Mucericeri
Sweet potato	Asante, Tigoni, KSP 20
Solanum Potato	Wanjugu (KSP-20), Kak/SPK – 004, KEMB -10, KEMB -13, Mugande
Upland Cotton	KSA 81M
Castor Bean	Kat/C9, Kat/C10
Safflower	KAT/SAF-2
Pyrethrum	Mo/70/1124, L/75/487, Ma/71/423, Ma/75/4, Kr/74/122, Ks/71/6, Ks/75/313, Ks/75/336, L/75/477, Sb/66/107, Ks/70/64, ma/74/223, Ma/70/1013, Mo/74/443, K218, K235, P4, 4743, Ks/71/96, Sb/65/58, Mo/70/845, Ma/62/428, 3093
Barley	Ngao, Sabini, Bima, Bahati, Ahadi
Proso Millet	KAT/PROS 1, P. 244
Rhodes Grass	Mbarara Rhodes, Masaba Rhodes, Boma Rhodes, Elmba Rhodes, Pokot Rhodes
Coloured Guinea Grass	Guinea Grass
Setaria Grass	Nandi Setaria, Nasiwa Setaria
Congo Signal Grass	Congo Signal
Sunflower	Kenya Fedha, Kenya White, Kenya Shaba
Sugar Cane	KEN 82-401, KEN 82-808, KEN 82-247, KEN 82-216, KEN 82-219 KEN 82-737

Table 28: Selected Crop Management & Harvest Technology Achievements in KARI Food Crop Programme

No.	Achievement
1.	Biological agent (*Tyhlodromalusaripde leon*) reduced cassava green mite by 70% in three local varieties of cassava (Maria, Sudhe and Obarodak) in western Kenya.
2.	Miticidal products (Kilitac, Pyegar and GC Mite) achieved comparable efficacy to standard products (Mitac and Dynamec)
3.	Evaluations were carried out on the effect of actively initiated solar curing to prolong fresh sweet potato storage life. The shelf life was significantly prolonged.
4.	KARI, CIP and Bukura institutes developed forty-seven sweet potato recipes.
5.	Three new models of stone chakkis were designed. They are more efficient in dehulling of dry land pulses.

Table 29: Selected Crop Improvement in Horticulture and Industrial Crops

No.	Areas of Crop Improvement
1.	Produced more than three tonnes of seed of the HART 89M cotton variety through cotton basic seed multiplication programme at the KARI Mwea centre.
2.	Identified two cabbage varieties; Fortuna F1 which is high-yielding and tolerant to black rot and Gloria F1 which is suitable for non-black rot areas.
3.	Identified two tomato varieties (RRP-Arusha and Kentom) as bacterial wilt resistant.
4.	Registered and released an improved French bean variety (Kutuless).
5.	Developed and disseminated two citrus gummosis management techniques to 21 farmers in coastal Kenya
6.	Developed and recommended optimal planting density of gladiolus corms (72 corms per m2) and tuberose (20 x 30 cm) to growers.
7.	Successfully developed technologies for rapid multiplication of Easter lily bulbs from leaf cuttings, and Asiatic and Oriental lilies from scales.
8.	Recommended a method for breaking dormancy in gladiolus using cold room temperature at 2-4°C against conventional methods (spraying of Rindite and Bromoethane).

Table 30: Animal Health and Production Programme Achievements

Programme	Achievements
Animal Management	Identified twelve plant species as having medicinal properties that are important in the health management of indigenous poultry. These include Aloe, pepper, sisal, and Neem.
Feeds and Feeding	• Developed improved feed technologies based on poultry waste. • Developed and disseminated a maize defoliation technology to alleviate livestock feeds constraints in small holder maize production systems, • Developed a tamarind castor oil technology to control mange in goats.
Tickborne Diseases Programme	• Quantified productivity parameters including morbidity, mortality, herd dynamics and milk production for smallholder dairy farms in coastal lands endemic for tickborne diseases and trypanosomiasis
Livestock Virology	• Developed tests for detecting rinderpest virus infections in cattle and buffaloes, • Developed a vaccine recombinant virus for high efficacy against rinderpest at 6 months post vaccination.

Source: KARI, 2005

APPENDIX 4: RESEARCH AND INNOVATIONS AT KEMRI

Table 31: Selected Research and Innovations at KEMRI

No.	Project	Funding Source	Collaborators	Expected Application
1.	Epidemiological research on leishmaniasis in Baringo	WRP	WRP, UoN	Leishmania epidemiology
2.	Epidemiological investigations of vectors and reservoirs of L. tropica	WRP	WRP	Leishmania epidemiology
3.	The impact of crayfish on schistosomiasis transmission in man-made habitats in central Kenya	USAID	UNM, DVBD,UCSB	Bilharzia control
4.	The effects of infection by Schistosoma mansoni on platelets and an investigation into the immunological responses involved	TDR/NCST	Wales, UoN	Immune responses in bilharzia
5.	Mechanisms of Leishmania uptake and transmission by sandflies	TDR	IPR	Leishmania Control
6.	Identification and characterization of antigens for a transmission blocking vaccine in leishmaniasis	TDR	IPR, Hebrew, Kenturky, KU	Leishmania Control
7.	Treatment of leishmaniasis with amphotericin	WHO	WHO	
8.	A study correlating infection by falciparum with genetic factors and T-cell	WRP	CVBCR, WRP	
9.	Preliminary study of bacterial agents and their anti-microbial resistance patterns in acute diarrhea	WRP	WRP	
10.	Molecular pathogenesis of severe malaria in children	TDR	JICA	
11.	Evaluation of etaquine (WR239605) compared with mefloquine for chemo-suppression in malaria	WRP, Smithkline	WRP, Smithkline	
12.	Safety, rectogenicity and immunogenicity of a candidate malaria vaccine RTSS	WRP	WRP	
13.	Acquisition of immune response to stage-specific antigens P. falciparum in children	WRP	Smithkline	
14.	Situation analysis of early diagnosis and treatment of cancer of the cervix	CRHCS		
15.	Molecular Epidemiology of Non-typhi Salmonella in Kenya	Wellcome		
16.	Acute Respiratory Infections (ARI)	JICA		
17.	Prevalence of resistance to betalactam antibiotics among clinical isolates of Gram negative bacteria	ISID		
18.	Community directed treatment for control of lymphatic filariasis: A Multicentre Operational Study	TDR		
19.	Evaluating the WHO-UNICEF Integrated Management of Childhood Illnesses (IMCI)	CDC/Atlanta		
20.	Validation of immunochomatographic test (ICT) for diagnosis of filariais	TDR		
21.	Genetics of hepatic fibrosis in schistosomiasis	NIH		
22.	Anaerobes associated with pelvic inflammatory disease (PID)	NIH		
23.	Intervention trial to reduce recurrent bacterial vaginosis	NIH		
24.	The patterns of terminal cancer referred to Nairobi Hospice			Cancer Epidemiology

25.	Knowledge, attitude and practice concerning safe motherhood among traditional birth attendants in Western Kenya	CRHCS		Safe motherhood in traditional birth
26.	Rectal carriage of non-typhi salmonella species in children with malaria	Welcome		possible implication for management
27.	A randomized, double blind comparative, placebo controlled study of Rifaximin in the treatment of bacterial diarrhoea in travelers	Sallix	Univ of Zurich & Univ of Texas	Potential prophylactic use in tourists
28.	Prevalence and pathophysiology of hyponatraemia in children in Kilifi, Kenya	Welcome	Univ of Hanover	Defining future research agenda
29.	A retrospective study of the arboviral causes of illness among children in coastal Kenya	WRP	CVR	Defining potential for epidemics
30.	Interaction between speech and language impairments and epilepsy in children following severe malaria	Wellcome	Institute of child health	Implications for rehabilitation
31.	Evaluation of cost and effectiveness of residual house-spraying and insecticide-treated bednets during the malaria epidemics in Kisii and Gucha	MERLIN	DVBD/MoH NMCP/MoH	Essential information for DoMC policy formation
32.	Understanding the mode of action of antifolates and fansidar resistance mechanisms in *P. falciparum* in Kenya	Wellcome	Univ of Liverpool	Potential new drug development
33.	Safety and efficacy of chlorproguanil-Dapson vs pyrimethamine-sulphadoxine in the treatment of uncomplicated malaria	Wellcome	Univ of Liverpool	Direct role in bringing new WHO supported affordable antimalarial to market
34.	Relationships between folate status and resistance to Fansidar	Wellcome	Univ of Liverpool	Implications for management
35.	Reactogenicity to malaria vaccine candidate proteins	Wellcome	Oxford Univ	Vaccine development
36.	Implementation and evaluation of a rural shopkeeper training program to optimise home-use of shop-bought antimalarial drugs	DFID	Wellcome	A drug distribution strategy
37.	Red cell deformability in severe malaria	Wellcome	Trop. Med. 7AIDS centre	To understand malaria pathology
38.	Cultural description of febrile illness in pregnancy among the Chonyi in Kilifi, Kenyan coast	Wellcome	Leeds Univ	Baseline data for community based studies
39.	Utility of combining artesunate with pyrimethamine sulfadoxine (PSD) in delaying emergence and spread of PSD resistance in malaria	Wellcome	Liverpool & Oxford Univ	Contributing to WHO metanalysis and to database for policy formation
40.	An open randomised trial of gentamicin in infants with severe infections	Wellcome	Oxford Univ	Informing clinical practice
41.	Finding the optimum dose of magnesium sulphate for cerebral malaria	Wellcome	Liverpool Univ & Trop. Med.	Potential new approach to management
42.	A comparative pharmacokinetic study on iv phenytoin, iv fosphenytoin and im fosphenytoin	Wellcome	UoN	Optimizing management of seizures
43.	Cost-effective analysis of malaria control strategies	Wellcome	-	Informing national strategy
44.	Incidence of hypoglycaemia in children in rural Kenya	Wellcome	-	Defining future research agenda
45.	Vertical transmission studies using AZT	KEMRI/JICA	JICA	HIV control/management

46.	Molecular epidemiology of non-typhi *Salmonella* in Kenya	Wellcome		Salmonelosis epidemiology
47.	Etiology of travellers diarrhoea in tourists on the Kenyan coast.	SmithKline /Beecham ALFA Wesserman	CGMRC, Univ. of Zurich & Hauston	Control of diarrhoea, Increase foreign exchange earnings, enhance quality of life for visitors.
48.	Prevalence of resistance to betalactam antibiotics among clinical isolates of gram negative bacteria	ISID		Antibiotic resistance surveillance
49.	Community -directed treatment for control of lymphatic filariasis: A Multicentre operational study	TDR		New strategy for filariasis control
50.	Evaluating the WHO-UNICEF integrated management of childhood illnesses (IMCI)	CDC		Control of filariasis and other helminths
51.	Validation of immuno-chromatographic test (ICT) for diagnosis of filariasis	TDR		Improved diagnosis of filariasis
52.	Intervention trial to reduce recurrent bacterial vaginosis	NIH	UoN / Univ. of Washington	Reduce bacterial vaginosis, possible reduction of HIV acquisition
53.	The effect of micronutrient supplementation and treatment of helminths on mobidity intensity of infection, re-infection rates, nutrition status, school participation and achievement	DANIDA	MoH, DBL, UoN, KU	School Health Progam Policy/package formulation
54.	An exploratory/study to identify clinical morbid events in a community exposed air pollution in Kenya	Bilance Netherlands	St. Mulumba Parish	Review of policies on housing infrastructure/ industrial set up
55.	Effectiveness of the health centre information system in warning of impending malaria epidemics	WHO	LSHTM	Early warning system on malaria epidemics
56.	The development of a non-disease specific measure of HRQL in Kenya	WHO	DVBD	Policy reviews
57.	The epidemiology of *Schistosoma mansoni* in Machakos district of Kenya: Factors affecting the snail populations and transmission of the parasite	TDR	DVBD	Applications of GIS Health Policy
58.	Female genital schistosomiasis (FGS): A Kenyan study to assess its extent and association with HIV	UNDP	CMR, CBRD	
59.	Iron deficiency anaemia in Kenya	UNICEF	MoH. UoN, SOMA-NET	
60.	Community based health education		KEMRI/JICA/ WHO	Community Health Education
61.	Smoking habits of primary secondary school teachers	KEMRI	-	Targeted tobacco prevention
62.	Asthma and Allergic disease in Nairobi School Children: A sub-proposal within the International Study of Asthma and Allergies in Childhood	ISAAC	WHO/Other ISAAC partners	To understand asthma epidemiology & health resource utilization in Nairobi
63.	WHO assisted multi-centre study of the early bactericidal activity of anti-tuberculosis	WHO	LSTHM	New methods for evaluating anti-TB efficacy
64.	The out-patient clinical management of cough in HIV infected adults in Nairobi, Kenya: A cohort Study	Rockfeller Foundation	Univ of Washington	Evaluation of treatment algorithims and improved HIV care
65.	Preliminary laboratory and clinical evaluation of the therapeutic potential of trioxolane (KE091/ATX) in the management of acute airways viral	KEMRI		Establishment of potential use of trioxolane in the management of viral URTI

	infections in Nairobi, Kenya			
66.	Two year cohort analysis of tuberculosis re-treatment at the Mbagathi District Hospital, Nairobi, Kenya	MoH	NLTP, MoH	Improved management of TB
67.	Drug resistance survey and DNA fingerprinting in two tuberculosis treatment centres in North-eastern Province of Kenya	ACU	NLTP, WHO	Drug resistance monitoring in TB
68.	Prevalence of initial and acquired anti-tuberculosis drug resistance in Kenya	WHO	NLTP, WHO	Drug resistance monitoring in TB
69.	A study of the possibility of chronic shedding and potential transmissibility of poliomyelitis and measles vaccine after vaccination of HIV-infected children	WHO	CDC	Information for polio eradication campaign
70.	Characterization of cytotoxic T-cell responses to malaria vaccine candidate antigens in Kenyans naturally exposed to Plasmodium falciparum malaria	TDR	CDC	Malaria vaccine development
71.	Reduced susceptibility to permethrin in Anopheles gambiae: Its operational significance in areas using permethrin-impregnated bednets	TDR	CDC	Early detection of mosquito resistance to insecticide
72.	Randomised, double blind, placebo controlled study of the tolerability and efficacy of artesunate plus sulfadoxine-pyremithamine (SP) combinations vs SP alone for the treatment of uncomplicated childholod falciparum malaria in Siaya District, western Kenya	TDR	CDC/MoH	Develop tools for insecticide resistance monitoring Advice on malaria treatment policy

APPENDIX 5: RESEARCH AND INNOVATIONS AT KIRDI

Table 32: Selected Research and Innovations at KIRDI

No.	Activity/Processes
1.	Improvement of protein quality of sorghum
2.	Fish Leather Processing
3.	Production of fermented soy sauce
4.	Production of ceramic glasses
5.	Sorghum fermentation and malting/ Sorghum Beer
6.	Extraction of essential oils
7.	Laboratory bench power supply
8.	Power alcohol plan / unit
9.	Water based ink
10.	Leather fat liquoring products
11.	Poultry feeds formulation
12.	Instantised/extruded weaning foods from sorghum
13.	Acetic acid from molasses and wood
14.	Vinegar from pineapple waste
15.	Alcohol from molasses, maize, cashew apples, wood waste, etc
16.	Annatto from bixa ovellana
17.	Oil from avocado pear
18.	Chalk and insulators from Kisii soapstone
19.	Barium carbonate from barites
20.	Bonemeal from bones
21.	Brake fluid from castor oil
22.	Particle boards from vegetable waste materials
23.	Methyl alcohol from wood
24.	Hecogenin from sisal waste
25.	Papain and bromelain from pawpaw and pineapple respectively
26.	Methane production from farm yard waste manure and sisal waste
27.	Nicotine Sulphate from tobacco
28.	Production of bio-pesticide from neem plant
29.	Potable alcohol production technology
30.	Cassava processing and utilization
31.	Electric insect killer
32.	Alternative building materials for housing
33.	Commercial clay processing for ceramics
34.	Improvement of traditional fermented "uji" processing
35.	Electric glass washing machine
36.	Hand-made paper technology from blends of sisal and waste paper fibres
37.	Characterization of water hyacinth in the compost manure development
38.	Development of a reactor still for rectificative extraction
39.	Development and commercialization of natural dyes from indigenous flora
40.	Wetlands project orbit chemicals
41.	Natural survey on pollution hazards caused by tanneries in Kenya
42.	Development of biogas from water hyacinth
43.	National survey on environmental pollution by the leather industry in Kenya

APPENDIX 6: QUESTIONNAIRE

1. Name of the institution: ——————————————————————

2. Type of research carried out at the institution: ——————————————————————

3. Number of staff employed: ——————————————————————

4. Number of researchers/scientists at the institution:——————————————————————

5. Categorize the number of staff employed:——————————————————————

6. Annual government budget allocation to the institution for the years 1992-2002:————

7. Annual Appropriations in Aid recorded by the Institution for the years 1992-2002:————

8. Innovations and/or inventions recorded in the years 1992-2002:——————————————————————

9. Number of innovations and/or inventions protected in the years 1992-2002:————————

10. Total amount of capital investment to develop the products or to achieve the afore mentioned innovations/inventions: ——————————————————————

11. Agencies that collaborated in the production of the specified innovations/inventions:——

12. The year in which the specified innovations/inventions were protected:——————————

13. The type of protection applied to the specified innovations/inventions:——————————

14. Major problems experience in protection of the specified innovations/inventions:————

15. Annual revenue from the specified innovations/inventions:——————————————————————

16. Recorded volume of domestic consumption of products/services supported by the specified innovations/inventions:——————————————————————

17. Recorded volume of export of products/services supported by the specified innovations/inventions:

18. Recorded earnings from export of products/services supported by the specified innovations/inventions:——————————————————————

19. Indirect benefits from the specified innovations/inventions:——————————————————————

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