Ownership of University Inventions: A Case Study of Benue State University's Centre for Food Technology and Research (CEFTER).

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Abstract

The research considers the legal question of who owns the intellectual property rights of products emanating from research and development arrived at from publicly funded research of Universities. In answering on questions of ownership and commercialization rights, the research uses Benue State University's Centre for Food Technology and Research (CEFTER) which is a World Bank sponsored research center as a case study for the doctrinal assessment. The research has found that, ownership of results oriented research capable of being patented and commercialized is not well defined at the university. This is as a result of lack of available research and intellectual Property policies that can help resolve such issues when called to task. The research therefore calls for the implementation of intellectual Property policy in line with the World Intellectual Property Organization and National Office for Technology Acquisition and Promotion Guidelines. These Guidelines are suggestively not only proactive in nature but are crucial for the establishment and maintenance of good working relationships between the collaborating organizations.

Introduction

This research seeks to answer two posers: first who owns a university invention (and Intellectual Property [IP] generally) at Benue State University, Makurdi? And secondly, what rights the university may or may not, have in the commercialization of the

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invention using the African Centre of Excellence (ACE) of the Center for Food Technology and Research (CEFTER) in particular. In determining ownership in research products and processes, the following documents will be considered for the policy case study namely:

(a) Benue State University Regulations Governing the conditions of service for senior staff
(b) Patent and Designs Act Cap P4 Laws of the Federations of Nigeria,2004
(c) WIPO's 'Guidelines for Developing IP policy for Universities and R&D Organisations (WIPO Guidelines).
(d) NOTAP's Guidelines on Development of IP Policy for Universities and R&D Institutions (NOTAP Guidelines).
(e) Statute for Benue State University Centre for Food Technology and Research.
(f) Memorandum of Understanding between the World Bank and Benue State University on Post-harvest losses.

The research postulates that, beyond the university Intellectual Property Policy and clearly delineated policies that may exist, several factors do help to establish who owns a university invention and these factors include whether, (1) there are express or implied agreements to assign ownership, (2) whether the inventor is employed by the university, (3) whether the invention was made within the scope of employment and (4) the question as to where and when the invention was made.[1] The research further argues that, under Nigerian Patents and Designs Act similar to that of the United States law, an inventor owns his inventions except where there is an express agreement providing for assignment of ownership of inventions to an employer or where an implied agreement to assign is found because the employee was hired or assigned to invent or solve a specific problem or served the employer in a fiduciary capacity. The

[1] Jean Weidemier "Ownership of University Inventions: Practical Considerations" http://www.iphandbook.org/handbook(visited on 5/11/2018)

implications of the foregoing are many but not limited that, it becomes important for the university to avoid the said quagmire by requesting employees, researchers and students to execute an Invention Assignment Agreement (IAAs). In determining ownership in research products and processes, the following documents were consulted namely; Benue State University Regulations governing the conditions of service for senior staff; Patent and Designs Act Cap P4 Laws of the Federations of Nigeria,2004; WIPO's 'Guidelines for Developing IP policy for Universities and R&D Organizations (WIPO Guidelines); NOTAP's Guidelines on Development of IP Policy for Universities and R&D Institutions (NOTAP Guidelines) and Statute for Benue State University Centre for Food Technology and Research.

Conceptual Clarifications:

Intellectual Property

Intellectual Property (IP) refers to original creations such as inventions; literary and artistic works; designs; and symbols, names and images used in commerce. IP is thus the creations of the human mind – the intangible intellect that translate into tangible products. IP involves inventive or innovative works of the mind expressed in concrete forms such as a brand name, business model, literary works, musical composition, software technological developments or improvements, pharmaceutical or biological inventions, works of art, etc. The underlying philosophy in intellectual property system is that due to the recognition of its intangible nature, special steps are needed to secure the protection of these rights. The idea is that, inventors and creators assured of legal protection of the fruits of their intellectual endeavors are encouraged to further invest time and resources into research and development for the benefit of the society in general and as an economic venture for the inventor. The essence of a good intellectual property system therefore is the encouragement of economic development and industrial growth. Relatedly, Intellectual Property Rights (IPRS) are rights protecting the use of these human creations and its major elements or forms in modern world include

patents, utility models, industrial designs, trademarks and service marks, geographical indications and layout of integrated circuits, copyright and plant breeder rights.

Ownership of Inventions

Patents are personal properties and all personal properties are choses in action and own- able at law. In almost all cases, the first ownership in IP rests with the person who created it, that is the inventor of a patentable invention; Ownership here implies the bundle of distinctively divisible rights and a plenitude of privileges that inures in the owner of the rights in an invented product. Ownership is a key element of enforceability, licensing, manufacturing, distributing or otherwise making exclusive use of one's invention. Under the Patents and Designs Act, distinction is made between a 'Statutory Inventor'[2] and 'True Inventor'[3] as well as right to be registered as patent owner where an invention is made in the course of employment or in the person who commissioned the work.[4] In determining ownership in research products and processes, the following documents will be considered for the policy case studies:

(g) Benue State University Regulations Governing the conditions of service for senior staff

(h) Patent and Designs Act Cap P4 Laws of the Federations of Nigeria,2004

(i) WIPO's 'Guidelines for Developing IP policy for Universities and R&D Organisations (WIPO Guidelines).

(j) NOTAP's Guidelines on Development of IP Policy for Universities and R&D Institutions (NOTAP Guidelines).

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2 Statutory Inventor under 2 PDA 2004 is defined as the person who, whether or not is the true inventor is the first to file or validly to claim a foreign priority for an invention.

3 Section 2(2) PDA defines a true inventor as one being entitled to be named as such in the patent, whether or not he is also the statutory inventor, and the entitlement in question shall not be modifiable by contract.

4 Section 2(4) PDA 2004

(k) Statute for Benue State University Centre for Food Technology and Research.

(l) Memorandum of Understanding between the World Bank and Benue State University on Post-harvest losses.

Commercialization

Commercialization is the process of introducing a new product or production method into the market. It is the organization of something in a way intended to make a profit. It is the process of making a product or service available for sale to the public.[5] Ipso facto, in this work, commercialization denotes the many ways in which IP may be transacted for gainful purposes and these may include, sale or assignment of the protected invention or product, franchising, licensing of the patented invention or creative work and royalties.[6]

Benue State University

Benue State University is an autonomous state owned and funded University established by the Benue State Government[7], Nigeria in 1992/93 academic session. The University is a public institution with the general function of providing higher education and encouraging the advancement of learning throughout Nigeria and the World in general. The vision of the university is to be a University of First Choice in Nigeria and Africa and to be among the top 200 in the world. In 2014, the Benue State University Governing Council approved the establishment of the Benue State University Centre for Food Technology and Research (CEFTER) with the core mandate of controlling agricultural post-harvest losses. The university won the World Bank grant of Eight Million Dollars ($8,000,000.00) Africa Centre of Excellence(ACE) covering a five

5 What is commercialisation https://www.bing.com (assessed on 9/11/2018)

6 Joseph jar kur "Intellectual Property Law and Entrepreneurship in Nigeria: Principles and Practice (Aboki Publishers 2015)111-117

7 Benue State University Edict NO 1 of 1991

year duration out of nineteen (19) such other centres in the West and Central African sub-regions.

Dialectics of the Right of Ownership of Patentable Inventions under the Patents and Designs Act, Cap P2 LFN, 2004

Scope and Criteria for Patents in Agricultural Research

The criteria for Patent Protection in Nigeria are governed by the Patents and Designs Act.[8] The relevant sections provides thus:

"Subject to this section, an invention is patentable

(a) If it is new, results from inventive activity and is capable of industrial application; or

(b) If it constitutes an improvement upon a patented invention and is also new, results from inventive activity and is capable of industrial application."[9]

Section 1(2) of the Act further interprets the applicability of section one above thus:

"For the purposes of subsection 1 of this section

(a) an invention is new if it does not form part of the state of the art;

(b) an invention results from inventive activity if it does not obviously follow from the state of the art, either as to the method, the application, the combination of methods, or the product which it concerns, or as to the industrial result it produces; and

(c) an invention is capable of industrial application if it can be manufactured or used in any kind of industry, including agriculture."

The hallmark of section 1(1)(a) denotes a scenario of an invention while section 1(1)(b) denote the scenario of an innovation in the field of technology. Protectable subject matter includes products

8 Cap p.2 LFN 2004 (hereinafter simply called the Act)

9 Section 1 of the Act.

or processes that are new and useful for diverse purposes including transport, health, communications, household equipment, et cetera. Germanely, patents may be used to protect new or improved electronics, mechanical and chemical products such as electric bulbs, motor vehicles, aeroplanes, different medicinal products, beauty care products, refrigerators, cookers, washing machines and other products.[10] The effect of a patent grant is to confer on the patentee, the right to exclude other certain commercial acts or exploitation of the invention. Such as in cases where the patent has been granted in respect of a product, the act of: (a) making, (b) importing, (c) selling, (d) using or (e) stocking for sale or use of the product. And in cases where the patent has been granted in respect of a process, the act of (a) applying the process or (b) making, importing, selling, using, stocking for sale or use of the product obtained directly by means of the process. With the monopoly granted, the inventor has the right to prevent or stop others from competing with him so as to enable him recoup his investment in time, resources and mental ability or idea. The patentee may then take benefit of his labour by:

1. Commercializing the product (and/or if a research tool, engage in further research on it).
2. Giving licences to exploit the invention to others in return for monetary consideration.
3. Share the benefits by collaborating with others in exploiting the invention. The right given to a patentee allows him to benefit from the fruits of his labour.

The law of patent focuses on functionality or usefulness of a product or process. According to WIPO (World Intellectual Property Organisation), the patent system contributes to technological development in five main ways:

(a) As an incentive to creating new technology;

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[10] OyewunmiAdejoke, Nigerian Law of Intellectual Property (Lagos: Unilag Press, 2015) p.14

(b) By providing an environment which facilitates the successful industrial application of new technology;
(c) By facilitating technological transfer;
(d) As an instrument of technological planning and strategy; and
(e) Through the provision of an institutional framework which encourages flows of foreign investment.

Conversely, the scope of patentable subject matter is severally limited by the Act and the Act[11] provides as follows:

(a) Plant or animal variety, or essentiality biological processes for the production of plants or animals (other than micro biological processes and their product); or
(b) Inventions the publication or exploitation of which would be contrary to public order or morality
(c) Principles and discoveries of a scientific nature are not inventions for the purposes of this Act.[12]

The Nigerian provision expressly excludes the patenting of plants and animals varieties i.e. special breeds having unique properties discovered through research or a biological process, i.e. natural pattern or systemic structure of living things which can be induced or repeated and applied to meet human needs. This section however grants patentability character to microbiological processes and their product. The implication is that, it encourages research into the field of microbiology, a field not well developed in Nigeria so as to push forward the development of technology in this field.[13] There is a burdensome standard in the exclusion of patentable subject matter to the disadvantage of indigenous people of Africa and the Nigerian PDA is not an exception. This is because, there exist lack of clarity on the criteria or rationale used to determine the exclusion of non-

11 Section 1(4)(a) and (b) PDA 2004
12 Section 1(5) PDA 2004
13 Akintola S "Intellectual Property Rights, Issues arising from Biomedical Research: Problems and Challenges for Nigerian Law" (2011) Unib Law Journal, p.122

patentable inventions as the distinction between plants and animal varieties (which may be excluded) and micro-organism (which may not be excluded) and micro-biological processes (which is not excluded) and genetic engineering methods (which may not be excluded). In other words, patents are not issued for naturally occurring substances because the product could not be called a new manufacture. Some further subterranean issues such as the material or fundamental difficulty inherent in attempting to precisely distinguish between these processes is contestable hence the difference between the two concepts lies only in the degree of technical intervention; scientific growth and industrial capacity or intervention in natural traits of plants and animals. The above provision is almost on all fours with Article 27(3)(b) of the Trips Agreement and has also introduced the same uncertainty that has bedeviled that aspect of the Trips Agreement. Under the concept of "essential biological" processes, classical plant breeding methods would be excluded from patentability but generic engineering methods would be patentable. What accounts for the difference in the two methods which achieve the same goal? One may be quick to add that, the difference between the two concepts lies only in the degree of technical intervention, scientific growth and industrial capacity or intervention in natural traits of plant and animals. Other issues that need classification are questions like what are essential biological processes? What are micro biological processes? How are they materially different as for one to merit protection while the other should not? One may be quick to add that, the difference between the two concepts lies only in the degree of technical intervention, scientific growth and industrial capacity or intervention in natural traits of plant and animals.[14]

In addition to the term that inventions contrary to public order or not moral would not be allowed, it is instructive to mention that, the Act does not define the benchmark for public order or morality and how such terms could be measured for the purposes of application

[14] J.J. Kur "Globalization of Intellectual Property Rights and Regime for the Protection of New Plant Varieties: A Nigerian Perspective" (2008) 1 BSUJPP p.227

in terms of patents. This qualification is desirable in a country like Nigeria that has a multi-ethnic, multi-cultural and multi-religious situation where the yardstick for and parameters for accessing morality differs among ethnic grouping, social orientations and religious lines and tribal dichotomy.

The Nigerian laws on IPR do not recognize and provide for IP protection of indigenous innovation in areas of health and medicine, foods and agricultural processes, or any other process of Research and Development. This is unlike the provisions of TRIPS which extend protection to copyright, patents, industrial designs, computer data, wines and spirits, and lay out designs of integrated circuits, including the control of anti-competitive practices in contractual licences. The provisions are in contrast with Article 27.3(b) of TRIPS which provides that members shall provide for the protection of plant varieties either by patents or by an effective sui generis system or by any combination thereof. In effect, research and scientific discoveries into plant varieties in Nigeria do not have first protection under Nigerian IP laws. This makes it possible for foreign research bodies that possesses the necessary advance technology and can undertake scientific experiments to claim first protection over the plant variety.

The consequences of such lacuna could be appreciated in the light of a political and legal dispute involving India and United States over the grant and registration of patent to a US based company (Rice Tech Inc) of a crossed breed product of basmati and Americas long grain rice "basmati" which is a name long used in India and Pakistan. After a long drawn legal battle, the US patent office eventually upheld India's claim that the name basmati has long been in public domain as it has always been cultivated in India and could not then be subject of IP in the US as claimed by Rice Tech Inc.

Non-obviousness, Prior Art and Development of Technologies for reducing Post-harvest Losses

The Patent Statute prohibits the granting of patent where the invention "…obviously follow from the state of the art"[15] either as to the method, the application, the combination of methods, or the product which it concerns, or as to the industrial result it produces. Indeed section 2(3) of the Act provides:

> In subsection (2) of this section, "the art" means the art or field of knowledge to which an invention relates and "the state of the art" means everything concerning the art or field of knowledge which has been made available to the public anywhere and at anytime whatsoever (by means of a written or oral description, by use or in any other way) before the date of the filing of the patent application relating to the invention…

The implication of the non-obviousness requirement is that, before any invention or improved invention or innovation is to be granted a patent,[16] an applicant has to meet high procedural and substantive standards. The non-obviousness requirement is often considered the core requirement of patentability. It has been called the "Ultimate Condition of Patentability".[17] An inventor is not entitled to a patent if her invention would have been obvious to someone working in the field, if that person took into account the entire "prior act" (everything in relevant fields that had been published, in public use, and so on).[18]The logicality of the grant of a patent is that, a claim which lacks novelty is said to be anticipated and a claim which lacks an inventive step is said to be obvious. Hence, to qualify for grant of a patent, the inventive step taken by the inventor must not be one which is obvious, or which follows logically from available information

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15 Section 2(b) of the Act

16 The Exclusive rights of a Patent relate to the exclusive right to exclude others from making, using, offering to sell, selling, or importing her invention

17 McJohn Stephen, Intellectual Property, Third Edition (Chigago: Aspen Publishers, 2009) p.252

18 Ibid, p.253

about the product or process. The inventor is required to have duly exercised his inventive faculty in a manner considered sufficiently ingenuous to justify the grant of the patent; otherwise the patent may be invalidated on the ground of lack of inventive activity. Obviousness therefore becomes a vital watch ward for an innovator so as to save time, energy and resources over improvements that may in the end be qualified as lacking in inventive activity. Obviousness can be learnt from the ice-cold innovation project instance for the reduction of post-harvest losses otherwise known as the *CoolBot* system. The CoolBot system is spearheaded by one Dr. Jane *Ambuko* of the University of Nairobi, Kenya[19] wherein the inventor has designed and manufactured a cold storage that can preserve produce for at least two weeks as compared to two days for highly perishable fruits and vegetables exposed to room temperature. The *CoolBot* system, which uses a standard domestic air conditioner equipped with a control mechanism to maintain a room at the desired low temperature depending on the produce being stored. The system cost about 3,000 US Dollars. This post-harvest technology has been successfully introduced in Bangladesh, India and the United States.

There exists several other programmes and projects such as the *IDE(I)* tomato packaging project as well as the domestic or Household Metallic Silo, which is a Rice post-harvest preventive technology introduced as part of the Swiss cooperation for development in Central America. It has a capacity of between 0.5 and 2 tonnes which is introduced to prevent food loss. Its effectiveness has been proven since the 1980s.[20]

Other associated technologies and innovations aimed at reducing port-harvest losses in Africa include:

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19 Under the University of California "Feed the Future Innovation Lab for Collaborative Research on Horticulture and supported by the U.S. Agency for International Development (USAID) https://www.feed thefuture.gov/article/icecoldinnovation-reduce-postharvest losses (accessed on 2/07/2016).

20 Majia D.J. "An overview of rice post-harvest technology: use of small metallic silos for minimizing losses http://www.fao.org/docrep/006/1475 (accessed on 10.8.2016)

(a) Aflasafe – being a biocontrol product developed by IITA in partnership with the United States Department of Agriculture (USDA) to reduce aflatoxin contamination in maize and groundnut. This product was ranked as the third top technology of the innovation challenge and is registered in Nigeria, Kenya, Senegal and the Gambia.[21]

(b) DryCard- Developed by Horticulture Innovation Lab and the University of California at Davies. It is a low-cost and easy to use technology that uses colored strips to measure moisture levels in grain. The high moisture levels in stored grain lead to attack by mold and spoilage as well as aflatoxin contamination.

(c) Motorized Groundnut Decorticator shelling machine; Beans Shelling machine; Melon Shelling machine – all developed by Nigerian Polytechnics[22]

(d) Solar Crop Dryers- Designed and constructed to replace the traditional open –to-sun technique to dry agricultural products and manure; As well as Solar Chicken Brooders designed to replace electricity, kerosene or gas heated chick brooders[23]

Bayh-Dole Act and Universities Patent Pattern

The passage of the Bayh-Dole Act by the United States (US) in 1980 laid the legislative foundation upon which granted recipient universities of federal research and development funds were granted the right to patent inventions and licence them to firms. According to Cervantes,[24] the main motivation of this legislation was to facilitate the exploitation of government to funded research results by

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21 IITA technologies http://www.iita.org/news-item/iita-technologies(accessed on 11/11/2018)

22 Umoh & Lugard "Commercialization of Indigenous Engineering Inventions and Innovations and the Packaging Factor(COREN) 23rd Engineering Assembly p74

23 Sambo AS "Commercialisable Renewable Energy Research and Development Products"(COREM) (n23)

24 Mario Cervantes "Academic Patenting: How Universities and public research organisations are using their intellectual property to boost research and spur innovative start-ups"http://www.wip.int/sme/en/academic_patenting(assessed on 08/11/2018 p.1

transferring ownership from government to universities and other contractors who could licence the IP to firms. At the end of 1990s, emulating the US policy change made many other countries such as Austria, Denmark, Germany, Japan to reform their research funding regulation and/or employment laws to allow research institutions to file, own and licence the IP generated with government research funds. The foregoing countries equally abolished the hitherto called "professor's priviledge" that granted acedamics the right to own patents. The right of ownership has now been transferred to the universities while academic inventors are given a share of royalty revenue in exchange.

In India, the promulgation of "The Protection and Utilization of Publicly Funded Intellectual Property Bill, 2008" is a re-modeling of the U.S. Bayh-Dole Act (1980). The legislation has many stated motivations including:

- to provide incentive for creativity and innovation;
- to ensure access to such innovation by all stakeholders for public good;
- to encourage innovation in small and medium enterprises;
- to promote collaboration between Government, private enterprises and non-Governmental organisations;
- to facilitate 'commercialization of intellectual property' created out of public funded research and development;
- to promote the 'culture of innovation' in India;
- to increase the responsibility of universities, academic and research institutions and other recipient organisations for Government funding;
- Enhance awareness about intellectual property issues, especially in universities, academic and research institutions.

According to Sampat,[25] the Indian Act model of the Bayh-Dole applies to all research resulting from government grants. As a condition of accepting government funds, institutions would face new obligations. First, they would have to disclose 'intellectual property' to the government and to notify the government of their desire to retain title. Second, institutions receiving government grants are required to create an intellectual property management committee. Institutions affected by the Act are obliged not to disclose or publish results until IP has been disclosed.[26] Like Bayh-Dole, it codifies the process through which institutions must disclose and report publicly funded IP. The Indian Bayh-Dole defines "intellectual property" broadly to include not only patents, the focus of Bayh-Dole, but also trademarks and copyrights. This singular expansive view of the Indian Bayh-Dole further creates strong penalties for grantee institutions and inventors that do not comply, including revocation of past and future grants, as well as various fines and penalties, as well as the "Indian First" provisions, including that any licences of government funded IP taken out in India must substantially manufacture and resulting products in India.[27]

In the same vein, prior to the promulgation of the Intellectual Property Rights from publicly- financed Research and Development Act of South Africa in August 2010, universities and research organizations in South Africa dealt with issues of IP ownership in whatever they deemed fit, as they had unfettered discretion to negotiate and /or agree on any terms of IP ownership with third parties such as private companies.[28] The Act has laid down new and unambiguous rules regarding ownership of IP generated from state funding. The IPR Act set out the conditions that must prevail for IP

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25 SampatBhaven "The Bayh-Dole model in Developing Countries: Reflections on the Indian Bill on Publicly Funded Intellectual Property" http://ictsd.org/www.iprsonline.org or www.unctad.org (visited on 30.9.2016)

26 Ibid, p.2

27 Ibid

28 Vutisile Hobololo "Intellectual Property CO-Ownership and Commercialisation in Public-Private Partnerships in South Africa" (2015) IAMOT International Association for management of Technologyhttp://

generated at publicly- funded R&D organizations to be owned by state funded R&D institution that developed it under section 4(1); co-owned by the publicly-funded R&D Organization and private organization under section 15(2); and where the ownership of such IP is negotiated between the collaborating parties and sections 15(4) and (5) of the IPR Act.

The South African experience determines ownership of IP resulting from R&D conducted at the publicly- funded R&D organization where state funds were used in whatever measure will, in terms of the IPR Act, vest in such publicly-funded R&D organization. However, in the event that R&D is conducted at the publicly-funded R&D organization without any use of state funds, then the ownership of IP generated in such circumstances may be negotiated, and agreed upon in any way that the collaborators deem fit.[29] The necessary implication of the foregoing also is that, an R&D project is deemed to have been funded on a full-Cost basis only if the funder paid both the direct and indirect costs of R&D.

In Nigeria, due to slow legislative intervention and lack of dynamic inventive culture occasioned by low industrial base, there is no equivalent of the Bayle-Dole Act in Nigeria. Indeed even after the promulgation of the much influenced Bayh-Dole Act, Nigerian Universities' IP drafting policies in the early 1990s was an all grabbing approach in favour of the Universities. But that did not help the entrepreneurial, revenue and development goals of universities and royalty rationing and that a good IP policy that can sustain innovation and RILs should provide in principle for; (i) Identification of university generated IPs. (ii) Ownership of IPs. (iii) Conflict of interest. (iv) IP income sharing arrangement and (v) Opportunity for collaborative linkages between research and industry.[30] These points

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29 Vutisile Hobololo (n25)

30 Kassim S Agbonika "Comparative Analysis of content consideration for University Intellectual Property Policy formulation"(2016)9 ABU Journal of Private and Comparative Law p154

are well referenced by WIPO[31] and mirrored by NOTAP[32] and are referred as standard documents which provide the blue print on formulating university IP policies.

Post Bayh-Dole Guidelines on Intellectual Property Ownership by the University

The promulgation of the Bayh-Dole legislation, has brought about a new dispensation underpinned by specific provisions which dictate circumstances that must prevail for IP to be owned by publicly –funded research and development organizations like universities and circumstances in which IP may be co-owned by publicly-funded R&D organization and a private company, and where ownership of IP may be negotiated between the publicly-financed R&D organization and a private organization. In addressing the issue of 'identification of university generated IPs', the WIPO Guidelines under 'coverage of IP Policy' identifies eight IPs relevant to university researches namely: Patents, Utility Models, Industrial Designs, Copyright in literary works, Geographical Indications, Trademarks and Trade Secrets.[33] NOTAP has similarly identifies as WIPO above but has added 'Know-How.'[34]BSU has no IP policy so called, however, the Regulation Governing the Conditions of Service for Senior Staff[35] references inventions[36] and by implication copyright[37] only. it is important to observe here that, University of Ibadan identified all IPs in WIPO Guidelines and added "UI Logo", Technology-based materials in online courses and Distance learning, research proposals, traditional knowledge and any other IP-related assets, created by persons covered by the policy"[38] while, Ahmadu Bello University has provided for Copyright, Patents, Electronic Online Materials and

31 Wipo Guidelines
32 Notap Guidelines
33 Article 26 Wipo Guidelines
34 Chapter II Notap
35 Hereinafter called the 2009 Regulations
36 Section 14
37 Section 15
38 Article 2.1.2 of Ibadan Policy

Trademarks.[39] It is instructive to observe further that, none of the universities mentioned and indeed several others have no provisions on Domain Names provisions and this is grave. Benue State University may leverage on this information to provide a conducive, comprehensive and up to date IP amenable guidelines that will include not just the routine IP species but that which will include BSU Logo, Electronic Online materials, domain names etc.

In addressing issues on 'Ownership of IPs', the WIPO model Guidelines contains 'the standard principles'[40] among which are the following:

i. **University Ownership of IP**-

(a) *Course of Employment*: Ownership is vested in the university if IP results from normal course of employment or responsibilities and /or if significant use of university resources (e.g. fund, university committed time, equipment, laboratory etc) is used.

(b) *University Commissioned Work:* Unless varied by written agreement, university owns all IP(including ESW[41]) resulting from research by anybody hired or commissioned by the university for that purpose.

ii. **Ownership of Sponsored or Collaborative Research**-

(a) *Sponsored Work:* Ownership of sponsored research will be governed and determined by terms of the grant or agreement.

(b) Collaborative Work: If there are several inventors in a collaborative research, ownership will be jointly shared subject to terms of collaborative agreement.

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39 Article 3.8 ABU Zaria.
40 Article 55-73
41 Exempted Scholarly Works

iii. **Individual Ownership**

(a) Individual Invention: IP generated by use of employee's own time and without use of University's resources belong to the employee.

(b) Assigned Invention: University may refuse, fail, neglect or delay to file for patent application over which it asserts ownership. In such cases, the university may select to assign ownership to the true inventor(s); the individual Assignment may also be subject to application by the inventor to whom the university assigns in writing subject to sponsorship restrictions.

(c) Students' Researchers: All IP generated from students researchers belong to the students unless the said research enjoys university funding, grant or financial aid or resulting from significant use of university resources or is subject to terms of an external research grant or sponsorship agreements.

(d) Exempted Scholarly Works (ESWs): these are Students' thesis, Dissertations and Project works. The ownership automatically vest in the student author subject to royalty-free licence of the university to reproduce and publish.

Notap's Guideline for IP ownership is in pari material with that of WIPO Guidelines except with the addition that, where equipment such as office, Lab, studio, computer hardware, et ce tera are acquired pursuance to an externally funded research, ownership of the equipment shall at the completion of the research revert to the university as university's property.[42] Here too, BSU Regulation is disturbingly silent on ownership and has not reflected on categorization of ownership as to whether individual or students'

[42] Article 7.1-7.6

researches nor collaborative research. The general provisions reflecting research ownership and assignment are generally ambiguous.

Conflict of Interest: Conflict of interest here refers to issues of discipline and ethical conducts associated with research such as plagiarism, non-disclosure clauses. A conflict of interest of commitment arises when an individual engages in an outside activity, either paid or unpaid, that may adversely affect their commitment to the university. Under this headline, WIPO's Guideline underscore the need for the universities to develop policies and procedures to manage such conflict.[43]With application to BSU, there exist ad hoc rules on these areas but there exist no clear research policies and thus wanting in that area as well.

Intellectual Property Income Sharing: IP income sharing policies are also well outlined. According to the WIPO Guidelines rule 111 and 112(as adopted by NOTAP) is as follows:

(i) General Revenue sharing principle for patented and commercialized invention made by a university employee using institution's resources is as following:
   (a) Gross Income: this goes to the university until the expenditure for protection and exploitation of the IP is subtracted.
   (b) Net Income: this is shared between the inventor and the university. The trend is the university's percentage share increases with the increase in the net total revenue while the percentage share of inventor decreases with increase in the net total revenue.

(ii) Each institution determine its stakeholders such as, the inventor's research group, campus, a faculty, scholarship

[43] Article 68

fund, patent fund, Technology transfer Office and the University et ce tera.[44] BSU do not have an income distribution arrangement as does other universities such as the ABU Policy that contains the following ratio under Article 3.11:

(i) Lump Sum
  (a) Inventor-40%
  (b) University- 60% (to defray all incidental expences)

(ii) Royalties
  (a) Inventor -33%
  (b) Department-33%
  (c) University-34%

Publicly-Funded Research and Intellectual Property Ownership: Practical Considerations at Benue State University The Centre for Food Technology and Research (CEFTER), is a Centre of Excellence for control of Post-Harvest food losses. The core mandate of CEFTER include:

(a) To develop a critical mass of well-trained students in the control of post-harvest losses;
(b) To empower African researchers to identify technologies that will reduce post-harvest losses;
(c) Development of technologies through applied research for reducing post-harvest losses;
(d) Engage communities, farmers and industries in the development and dissemination of technologies in post-harvest losses.[45]

Since the establishment of the Center, the Center distinguished itself in 2015 when it won a World Bank grant for the establishment of an African Centre of Excellence (ACE) in Nigeria

[44] Kassim S Agbonika (n 27)
[45] www.cefterbsu.edu.ng (visited 29/07/2016)

for the development of research to reduce post-harvest losses. Pursuance to CEFTER's mandate, the following technologies has been developed by the centre:

S/N	Name of entrepreneur developer.	status	Product (s)	Value addition and benefits	Suggested registration	Remarks
1	Tar Sesugh	MSc. Post harvest engineering student.	Passive solar drier for drying of vegetable products.	*Environmental friendly. *Economical saves time and energy	Patentable invention	
2	Michael Tersteagh	MSc. Post harvest engineering student.	Active solar drier for drying of tomatoes	*Environmental friendly. *Economical saves time and energy	Patentable invention	
3	Apaa Jacob	MSc. Post harvest engineering student.	Improved the shelve life of mango fruits using gamma irrigation and evaporative cooling	*No preservatives. *highly nutritious and well packaged to sustain life shelf.	Process invention (but not available in Nigeria)	
4	Beba Shedrach Luper	MSc. Food science and Technology	Produced bread from wheat default and beetroot composite flour.	Fortified with vitamins and recommended for diabetic patients.	Trademark	
5	Veronica Angbiandoo Ashaver	MSc. Food science and Technology	Produced pulse electric field equipment in the treatment of orange juice.	Improved technology	Patent.	
6	Josephine Njoughul	MSc. Food science and Technology	Came out with quality studies on living stone potato	Improved knowledge	Discovery	
7	Aben Ben	PhD. Fish post harvest technology	Fabricated and improved fish drier.	*portability *Mechanically operated and does not require electricity.	Patent	
8	Aben Ben	PhD fish post harvest technology	Produced fish fortified baby formula and fish spices	Natural and hygienically processed and nutritious.	Trademark	

Source: www.cepterbsum.edu.ng

Apart from the above products and products improvements, a lot of value added products that also add to innovative assets and value chain on the agricultural products that can nevertheless constitute properties of Intellectual Property creation in patent, trademarks or trade secrets include: Products like the "Demobilizing Spray" (which can be used in place of tear gases by security personnel and citizens alike) which was developed by a group of researchers from pepper with an inventive character under Patent and Designs Act. Other products with value addition which Students/ Researchers at the institute incubated include:

S/N	Name of entrepreneur / developer.	Status	Product (s)	Value addition and benefits	Suggested registration	Remarks
1	Group work (products from rice)		Zaza, Rice Cookies, Risem, Jannil, Tusha, Rice Cake	An improvement on what is obtainable from rice with high energy supply. -highly economical with improved packaging.	Trademark	
2	Group work (Products from Fish)		Plan Fish Cookie, G Fish Cookie, Fish Ball	Rich in protein, highly economical with improved packaging.	Trademark	
3	Group work (Products from Soya Bean)		Soy Biscuits, Soy Flour, Soy Powder Milk, Soy Animal Feed, Soy Soup	100% fresh and natural. No additives, no artificial preservatives and odorless soya beans.	Trademark	

4	Group work (Products from Corn)		Corn bread, free sugar popcorn, corn grit	Fortified with vitamin A products.	Trademark	
5	Group work (Products from Orange)		Orange Crunches, Orange Muffin, Orange Cookies	It is a juice extracted and packaged as orange with low sugar content	Trademark	
6	Group work (Products from Tomato)		Tomato Juice, Tomato Salsa, Tomato Ketchup, Tomato Puree	Waste to wealth	Trademark	
7	Group work (Products from Mango)		Mango Roll ups, Mango Crisps, Mango Jam, Mango Drink	Sugar free, handy and attractive.	Trademark and geographical indication	
8	Group work (Products from Beniseed)		Sesame oil, Sesame Milk, Sesame Yoghurt, Sesame Animal feed	Raw material are sourced locally	Trademark and geographical indication	
9	Group work (Products from Pepper)		*Benue Hot Scotch Bonnet, *BSU Magic Puree, *Demobilizing Spray; *White Pepper, Kembe's Essential Oil	Packaged using agric proceeds Packaged using agric proceeds Local content and technology	Trademark	

Source: 2018 Cefter year publication on Cepter week

At the Benue state University, the CEPTER programme is funded by the World Bank in collaboration with Benue State

University. The projects are benefiting mainly from public investment and public funded organisations publicly funded and goods produced are public goods. These goods which are information, data or products, are released into the public domain for adoption and utilization by and for the benefit of all people of the nation. The immediate implication for intellectual property rights and patents in particular are who owns the intellectual property right in such creations and innovations? Who commercializes the University Research? How are the benefits or profit shared among the stakeholders?

The issues related to intellectual property rights has become increasingly important within universities and research and development (R&D) institutions in Nigeria and Africa generally. This is particularly so with respect to the current desire by most universities to generate income through consultancy, technology transfer and commercialization of innovations, inventions and research findings. In reality, employee inventors develop the overwhelming majority of inventions patented today. Under the default rules, an employee owns the subject matter of his invention or innovation even if the invention was conceived during the course of employment, except if there has been an agreement to the contrary. In Nigeria, the rights are not clearly spelt out. Section 2(1) of the Patent Act provides:

> Subject to this section, the right to a patent in respect of an invention is vested in the statutory inventor, that is to say, the person who, whether or not he is the true inventor, is the first to file or validly to claim a foreign priority for a patent application in respect of the invention.

Section 2(4) further provides:

> Where an invention is made in the course of employment or in the execution of a contract for the performance of specified work, the right to a patent

> in the invention is vested in the employer or, as the case may be, in the person who commissioned the work.
>
> Provided that, where the inventor is an employee, then
>
> (a) If
>
> (i) his contract of employment does not require him to exercise an inventive activity but he has in making the invention used data or means that his employment has put at his disposal, or
>
> (ii) the invention is of exceptional importance, he is entitled to fair remuneration taking into account his salary and the importance of the invention.

The Nigerian patent law does not recognize the statutory default rule which an employee owns the subject matter of his invention even if the invention was conceived during the course of employment. At the Benue State University Article … of the Condition of Service provide as it relate to Invention thus:

> S.14.1 A member of staff who has made an invention during the course of his work shall immediately report it to the Vice Chancellor. Staff shall, at the expense of the University if so required by the Vice Chancellor lodge an application for provisional protection of the patent.[46]
>
> S.14.3 As soon as practicable, the Awards Committee shall reco[47]mmend, and Council will decide, whether the member of staff shall be allowed controlling rights in the patent. Pending Council decision, the rights shall be deemed to belong to and

[46] S.14(1) of Regulations Governing the Conditions of Service for Senior Staff, Benue State University.

[47]

be held in trust by the University. Where an invention is in all respects alien to the employment of the member of staff, he will normally be granted the controlling rights. If the member of staff is allowed the controlling rights, the following provisions shall apply:

i. Staff will be responsible for all expenditure for taking out the patent.

ii. Council may attach to its decision such conditions as it may think fit and in particular, may reserve to the University a right of user of the invention free from royalty and/or may reserve the right to a share of any commercial proceeds.[48]

S.14.4 If the staff is not allowed controlling rights of patent, the following provisions shall apply:

i) The staff shall assign all his rights in the invention to the University.

ii) The University shall be responsible for all expenditure in taking out the patent.

iii) The University Council shall decide whether the staff shall be allowed a share of any royalties or commercial proceeds.[49]

S.14.5 Whether or not he is allowed controlling rights the member of staff may apply to the Awards Committee for an award in respect of his invention. In fixing the amount of any award or share of any commercial proceeds:

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[48] S.14(3) Ibid

[49] S.14(4) Ibid

i. Any reasonable expenses incurred by the member of staff in respect of the invention shall be taken into account.

ii. The reservation of the right of user, free of royalty by the University, shall not be taken into account, but if and when such right is exercised by the University, a material change calling for modification of the award shall be deemed to have taken place.[50]

These provisions are draconian both in spirit, intent and wordings. The rules are not in tandem with global practices and if Benue State University indeed wants to be a citadel of knowledge within the community of world best Universities, then the Council of Benue State University should amend same. This rule creates unhealthy and inhibitive innovative practice in Research and Development pattern at the university and calls for a better management tool so as to identify, harness, secure, manage and exploit the intellectual properties which the university may generate.

The provisions are draconian because, several factors help to establish who owns a University invention and what rights the University may or may not, have. These factors include whether, there are express or implied agreement to assigns ownership; whether the inventor is employed by the University; whether the invention was made within the scope of employment and where and when the invention was made[51]. The starting point of the law is that individuals own their inventions except through an Invention Assignment Agreement (IAAS), there exist an express agreement providing for assignment of inventions to an employer; and where an implied agreement to assign is found because the employee:

(i) was hired or assigned to invent,

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50 S.14(5) Ibid

51 Weidermier Jean 'Ownership of University Inventions: practical Consideration. http://www.iphandbook.org/handbook/ch05/p04 (accessed on 10/09/2016)

(ii) was hired or assigned to solve a specific problem,

(iii) Served the employer in a fiduciary (president of a commercial company, for example).

Where no written agreement exists and no implied contract to assign is found, the inventor will own the invention. To address these questions, Japanese patent law has introduced the notion of an "employee's invention"[52] and gives individual inventors the right to apply for patents at the expense of the employer. The Japanese Act has tried to balance equilibrium in perceived acknowledgement of the fact that, the employers contribute in various ways to the completion of the invention by employees. They pay a salary to employees. They provide facilities and funding for research. The Act therefore, provide them free-of-charge, non-exclusive licences to use employee's invention and obliges employees to assign the right of their employee invention to employers[53] under a special contract or internal regulations.

Another area in which the Japanese Law makes instructive insight by striking a balance between employers and employees, taking into account the weaker position of employees in general is with reference to the question of reasonable remuneration[54]. The Law provide for factors to be considered when negotiating "reasonable remuneration" to include; the profit that employers will make and the contribution by employees[55]. This parameter resolves the thorny issue of what employers think "reasonable remuneration" as against what the employees think "reasonable remuneration". Two cases indicate the relevance of the above discourse whereby a Japanese scientist (now a professor in a USA University) sued his former employer claiming 200 million Yen (about 1.7 million US Dollars) arguing that he had not received enough remuneration for assigning

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52 Section 35 Japanese Patent Law paragraph 1

53 Section 35 Japanese Patent Law paragraph 2

54 Nakayama Ichiro "Patent Ownership and Rewards for Inventions in Japanese Public Research Organisations

55 Section 35 Japanese Patent Law paragraph 4

the rights to his invention to his former employer[56]. Another is the case of *Tanaka v Olympus optical Hanrei Jiho*[57], where the court held that, while employers could unilaterally establish internal regulations that require employees to assign the rights to invention, employers were not allowed to decide unilaterally the amount of remuneration. It continued that, if remuneration set forth unilaterally by an employer was not enough, an employee was entitled to ask for more. In yet other cases, the courts held that, contractual arrangements and internal codes should not be able to override employee claims for remuneration[58].

The tussle of University ownership of patent was put to test in the case of *Stanford v Roche*[59]. In that case, a Stanford University (Stanford) researcher, Dr. Mark Holoding, visited Roche Molecular Systems (Rochie) to learn about a then novel technique called *Polymerase Chain Reaction* (PCR)[60]. When he returned to Stanford nine (9) months later, Holoding combined what he learned at Roche about PCR with Stanford's expertise in *Human Immuno Deficiency Virus* (HIV) to develop a PCR test for quantifying viral load in HIV positive patients. The events that gave rise to the entire litigation were that, before he ever set foot at Roche, Holoding executed a Stanford employment contract agreeing to assign all his future inventions to Stanford, but when he later arrived at Roche, Holoding executed a Visitor Confidentiality Agreement (VCA) in which he "hereby assign" to Roche all of his inventions that related to his activities there[61]. As a result of these conflicting assignment contract, both Roche and Stanford thought they were rightful owners of Holodings's invention. In due course, Roche's own scientist successfully commercialized the PCR-HIV test invention while

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56 Nakayama I, op. Cit. P.3
57 (2001) 23 Tokyo High Court
58 Tsujimoto v Minolta (1984) Osaka District Court
59 Leland Stanford Junior University v Roche Molecular System International, 131 S.ct 2188, 2192 (2011)
60 Yeh Robert M, "The Public Paid for the invention: who owns it? (2012) 27 Berkeley technology Law Journal p. 452
61 Ibid. P. 457

Stanford, with Holoding as one of the named inventors, obtained a patent that purportedly covered the same invention without naming Roche scientist as co-investor. When Stanford tried to enforce its patent, Roche declined to pay royalties or acquire a licence, and so a law suit ensured[62]. When the dispute reached the Supreme Court, Stanford argued that because Holoding's invention was founded in part by the Federal Government, the Bayh Dole (BD) should trump all private contract that would otherwise determine invention ownership. The Supreme Court held that, an investor remain the ab initio owner of his federally funded invention regardless of BD, and that BD only comes into the picture after the contractor, in this case Stanford, receives the invention via assignment under ordinary contract Law[63].

The Stanford case raises two key issues namely;

(a) Whether BD trumps private contracts which the Supreme Court has said that the BD does not trump private contracts.

(b) That a contractual language is necessary to effect a present assignment of a future inchoate invention through the use of certain terms like "hereby do assign" or "hereby assign" language as a necessary tool to effect transfer of future, inchoate investment[64].

Consequently, the Stanford decision put Universities on notice that if they want to avoid the legal quagmire in Stanford, they need to ensure that they effectively receive ownership via assignment from their employee-inventors through an employee-inventor contract guaranteeing present assignment of future inventions using the "here do assign" phrasing, instead of merely promise to assign future inventions[65].Comparatively, there exist, wide divergence of statutory legal regimes governing ownership of Public Research

62 Ibid.
63 Ibid.
64 Ibid. P. 452
65 Ibid.

Organisations (PRO). In Europe, IP related legislation identifies three different types of regimes namely, employment and IP related legislation; government Research regulations and Contractual arrangements with industrial sponsors.[66] In relation to the ownership under employment regime, IP legislation in Europe generally identifies three types of invention. First is the service invention (when the act to invent is a function covered under the employment agreement); free invention (which is made independently of the employment arrangements by relying in no way on the resources or expertise of employment; and dependent invention made outside the scope of the employment but making use of information, materials or equipment owned by the employer.[67]

Under the ownership under Government Research Regulations, even though the IP rights on the research results and inventions may initially vest in the PRO where the research has been conducted, the ownership will ultimately pass to a research sponsor as a condition of funding. In this regard, no distinction is generally drawn between the result of the research and commercially applicable invention.[68] The distortions under this arrangement resulting into the possible maladministration of ownership rights enabled European countries to adopt the United States philosophy of the Bayh-Dole Act[69]which law gave the PROs the option to elect to own the invention on the condition that they would seek patent protection, diligently promote commercial use through licensing, which could be made exclusive and that the inventors would enjoy a share of the net proceeds in the case of successful exploitation.

Under the ownership and industry sponsored Agreements, the Scheme relies on the model provided by the United States Bayh-Dole Act which provide the right for PROs to take title to inventions

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66 MacDonald L ettel, Management of Intellectual Property in Publicly-Funded research organisations: towards European Guidelines, http://europa.eu.int/comm/research/rtdinfo/index_en.html.

67 Ibid, p.25

68 Ibid

69 Ibid, p.15

applied to all research funded in whole or in part by Federal Funds.[70] Under this arrangement, PROs generally insist on owning the results of collaborative research funded in part by industry in exchange for granting royalty free non-exclusive licences rights. These non-exclusive licences are granted in exchange of fair compensation. However, in contrast, the common practice in Europe has been for industry partners to insist on receiving full ownership of the research result they sponsor and to retain the first (only) right to file patent applications.[71] This practice, plausible as it may be, caution requires to be exercised by the PROs in that, a surreptitious management of the intellectual property assets may breed crisis of a distinction being made between ownership of the results and ownership of invention. The result of a research may have many different forms and have implications on many different fields that are not easily identified or protected. One such implication may be that, an earlier research will equally become the basis of further research.

In this direction, there exists the need for collaborative research agreement involving private, public and governmental institutions on the one hand and CEFTER on the other hand that will serve the interest of both types of entities. Benue State University may use these agreements to set up Research Trust Fund that would not be completed for lack of governmental funds or resources. These cooperative arrangements may further support new revenue to the University if the innovations lead to commercially successful products. Considering these challenges and the objectives of establishing CEFTER and several other Research Institutions, the following recommendations are proposed:

1. Benue State University should as a matter of necessity and urgency consider for implementation a research policy and an Intellectual Property Policy. The IP policy should be one that will balance up contentious areas of ownership (inclusive of the IAA clauses contract) and royalty rationing.

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70 Ibid
71 Ibid

2. Benue State University should establish a Central Intellectual Property Management body under the office of the Vice Chancellor with budgetary allocations. The central IP Management body will have the following functions:
   (a) Assist the researchers in issues of IP, access to adapted technologies, technology transfer and ways of protecting their inventions;
   (b) Initiate and promote negotiations needed for licensing proprietary assets at institutional level;
   (c) Vetting all proposed Memorandum of Understanding and research grants to be entered into by the University for Purpose of understanding the pits and substances in them.
   (d) Introduce the use of IP management parameters during research project planning.
   (e) To educate and create awareness about IPR among researchers and Management personnel.

3. There is need for the National Assembly through the Nigerian Law Reform Commission to enact or adopt "The Bayh Dole Act" (University and Small Business Patent Procedure Act). The Bayh Dole Act is a United States Legislation dealing with Intellectual Property. The innovation of the law is that, Universities retain ownership to inventions made under federally funded research. In return, Universities are expected to file to patent protection and to ensure commercialization upon licensing. The royalties from such ventures are shared with the inventor: a portion is provided to the University and department/college; the remainder is used to support the technology transfer process. The main purpose of the Act is to further development and commercialization. However, in adopting the Bayh Dole Act for implementation in Nigeria, the Indian model can be ignored. The United States Bayh Dole Act contemplates only

technological innovations and inventions. Innovations and Inventions are only within the purview of the patent laws with its attendant triple requirements. However, the Indian perspective known as "The Protection and Utilization of Publicly Funded Intellectual Property Bill, 2008" which remodeled the US Bayh Dole provisions by including creativity, innovations in small and medium enterprises, commercialization and generally, the Bill defines Intellectual Property generally to include Copyright and Trademarks. In this direction, CEFTER will be able to commercialize its products.

4. In view of the stringent and universal requirements that is required in inventions, there is need for the Centre to resort to Adaptation of technology among the more technologies existing that may be relevant to a particular crop (i.e. yam, mangoes, rice, oranges) that will be developed, innovated or remodeled to suit local circumstances that will aid post-harvest losses reduction as does the Coolbot system. This Centre can do in collaboration with local technicians and researchers as well as departments such as Vocation and Technology of the university and other schools such as University of Agriculture, Makurdi.

Conclusion and Way Forward for CEFTER

Post-harvest technologies can contribute to food security in multiple ways. They can reduce Post-Harvest Losses (PHL), thereby increasing the amount of food available for consumption by farmers and poor rural and urban consumer. The benefits to the consumer are enormous such as improving their food security, lower prices and improved quality of food products. In addition, post-harvest activities such as processing and marketing can create employment (and thus income) and better food security in the agricultural sector through improved farm level productivity. The overall effect of the foregoing is that it creates a value chain, however, achieving the goal is quite

challenging. In order to do so, one must first understand the various causes of post-harvest spoilage[72] which may be, biological or microbiological, chemical and biochemical, mechanical, physical or psychological or physiological[73]. Other causes of losses considered as secondary may include, improper harvesting and handling; inadequate storage facilities, inadequate transportation, inadequate refrigeration and inadequate marketing system[74].

The foregoing spectrum of losses associated with postharvest spoilage indeed do require some technical intervention and innovation through product patenting or process patenting or through the process of improvement patents recognized by Law. Biological or microbiological control on postharvest diseases for instance, in fruits, vegetables, grains et cetera is patentable; likewise would methods invention relating to substances intended or produced or prepared by chemical processes to reduce postharvest.

Agricultural machineries in the use of equipment and machines represent the mechanical and physical inventions used in postharvest activities. The use of agricultural machinery leads to better utilization of inputs and improvement in agricultural operations. Traditional agricultural machineries were tractors and drillers; however, there has been an increase in the innovations in machinery in the pre-harvest as well as postharvest operations. Deductions from India shows a high level of inventions and innovations in the irrigation systems and devices wherein patents are filed in invention like Drippers, sprinklers, emitters and hoses with dippers accounting for the highest number of application[75].The innovations in drippers relate to bottle dripper (236/mum/2005A), variable droplet irrigator (IN/PCT/2002/01 048/KOL) and disc shape dripper (498/DELNP/2007 A) while inventions on irrigation pipes,

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72 Ramaseamy Hoshallic "Postharvest Technologies of Fruit and Vegetables

73 Ibid.

74 Ibid.

75 Manchikanti P, and Sengupta M, "Agricultural Machinery in India: IPR Perspective" (2011) 16 Journal of Intellectual Property Rights pp. 165 – 166.

tensiometres and pumps can be considered as the second level of innovation in the area[76].

Considering the above issues, a better way out seems to be the option of postharvest adaptation technologies. This can be achieved if researchers in Nigeria focus on solar technologies rather than energy or electricity supply grid. Solar inventions would seem highly relevant for addressing some of the Africa's most pressing environmental needs.

[76] Ibid. P. 168