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BIOENTREPRENEURIAL COMPETENCIES AND ENGAGEMENTS IN CASSAVA WASTES-BASED COTTAGE INDUSTRIES: ENVIRONMENTAL AND SOCIO-ECONOMIC IMPLICATIONS

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Abstract
Bioentrepreneurs develop and commercialize their scientific ideas and research results based on biological processes and systems for producing goods and services, or exploit opportunities for marketing scientific expertise. Level of competencies for bioentrepreneurial development and commercialization of foods and industrial raw materials from cassava wastes (CW) was studied using survey design. The study sample consisted of two hundred (200) male and female adult respondents randomly selected from four communities in Rivers State, Nigeria .A structured questionnaire of 4-point Likert scale study titled, "Level of bioentrepreneurial competencies and industrial engagement questionnaire" (LOBECAIEQ) was developed and used in collecting data for this study. Reliability of instruments was carried out using Cronbach's alpha at 95% confidence limit with r =0.884. Data were analyzed using mean, Pearson's product moment correlation and analysis of variance (ANOVA). Results indicated that levels of entrepreneurial competencies for engagement in CW-based ventures was acceptably high ($\chi > 2.5$) with male>female, although actual engagement was low for higher bioconversion (h ($\chi < 2.5$). There were no significant correlations between male and female responses (r<1.00; p<0.05). Bioentrepreneurship in promotes capital and job creation, with attendant socio-economic gains among rural and urban dwellers in addition to fostering environmental protection and conservation. Recommendations for overcoming the bioentrepreneurship initiative bottlenecks were listed.

Keywords: *Bioentrepreneurship, Cassava waste, Engagement, Entrepreneurship, Environment*

Introduction

Entrepreneurship is the ability and willingness to formulate, organize and manage a business outfit either alone or with anyone to make profit. An entrepreneur creates a new business, bearing most of the risks and enjoying most of the rewards, which among others is making money (Hayes, 2021). An entrepreneur is an originator, initiator or innovator of a new business or financier. The entrepreneur plays a key role in the business culture of any country, and particularly as a job and wealth creator (Ejjibe, 2012). The idea of Bioentrepreneurship is borne out of the belief that a biological research and result is not just meant to be published in a journal and archived, but can be turned into capital (Dinglasan et al, 2011) by either exploiting the opportunities such results can offer to create products or services for human needs. According to daSilva et al., (2002), advances in biological sciences offer opportunities for improving the quality and quantity of healthcare and general welfare. Bioentrepreneurship is wealth creation derived from the application of the biosciences to the business context. Bioentrepreneurs look for commercial value in the technologies that they apply in conducting research in the field of biotechnology. While traditional entrepreneurs are involved only in developing and marketing of their product, Bioentrepreneurs have in-depth knowledge of the product itself and may also be involved in marketing it personally or using agents (Young& Mehta, 2004; Lehrer &Asakawa, 2004). One area where Bioentrepreneurs have made huge impact is in food biotechnology - processing crop or crop residues and

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transforming wastes into specialty commodities. Most food crops are being used for non-food purposes to provide food security as well as meet industrial needs. One of such crop is cassava (*Manihot esculenta*). Cassava provides a source of carbohydrate for people in sub-Saharan Africa (Hahn et al., 2010). Nigeria, Brazil, Congo Republic, Indonesia and Thailand are among the world's major producers of cassava (FAO, 2014). Global cassava demand is on the increase because of the non-food demand.

Cassava has diverse use values that range from food for humans to economic benefit, animal feed, pharmaceutical/medicinal, cultural, and spiritual values. Cassava roots are usually peeled to remove the thin skin and leathery layer (Onyimonyi & Ugwu, 2007). During the processing of cassava tubers into foods, enormous quantity of cassava peels are generated as waste (Oboh, 2006; Ubalua, 2007; FAO, 2008). Another type of waste from garri production step is cassava wastewater (CWW), while cassava root sievate is obtained during *fufu* production (Figure 2). Cassava waste peel poses a disposal problem as only a small proportion is used directly as goat feed. Cassava residues and wastes are potential industrial feedstock if exploited properly by biotechnological systems. In view of the above, Bioentrepreneurs have understood and perfected technologies for converting cassava wastes (and other lignocellulosic wastes) into commodities that still meet food, energy and industrial needs. This study therefore focuses on ascertaining the competencies possessed by male and female adults in selected urban communities from Rivers State to enable entrepreneurial engagement in cottage industries. It also investigates the constraints to start up bioentrepreneurial ventures based on cassava wastes technologies and highlights the implications of engagement on the socio-economic wellbeing of the people as well as their environment. The study attempted to answer the following research questions:

1.To what extent do male and female rural-urban dwellers possess bioentrepreneurial competencies for engagement and exploitation of cassava wastes?
2.To what extent are male and female adults in urban communities engaged in entrepreneurial ventures based on cassava wastes as raw materials?
3.To what extent does bioentrepreneurial exploitation of cassava wastes affect environmental health?
4.To what extent are urban communities constrained in exploiting bioentrepreneurial potentials of cassava wastes?

Literature Review

The concept, Bioentrepreneurship, bioentrepreneurial competencies and needs

Entrepreneurship involves generating value, the process of starting or building new profit-making ventures, the process of making new products or services available. Lehrer & Asakawa (2004) used the term, "science entrepreneurship" to mean the simultaneous dedication of scientists to academic science and economic profit", i.e. it focuses on commercializing scientific finding. One of such area of commercial application of science is in biotechnology, which is the use of biological organisms and systems for bioindustry. A person in such venture can be termed a bioentrepreneur. Turning biological sciences into business usually emerge when a scientist or an individual discovers a pathway or mechanism in biology that can fetch money. A bioentrepreneur is invents a business or perceives the market need for the product or service based on biological processes and systems (Mehta, 2004). In the latter case, the bioentrepreneur sees the market needs of his/her invention/product and builds a business to exploit that opportunity (Blank, 2013). Bioentrepreneurship may mean starting up a new business using biological principles and skills. It exists when a person develops a new approach to an old business or idea. The bioentrepreneur like other entrepreneurs must be able to recognize opportunity,ensure that the his/her perception of the relationship between the invention and the final product is refined into a business model that will explain how the industry will create wealth or product for other people that would like to invest in the business (Mehta, 2004). They launch their products, with a business model of forming a fully integrated company. Bioentrepreneurs background is as diverse as individuals in any other fields.

A key ingredient in a successful entrepreneurship is self-knowledge. Bioentrepreneurs must know their strength and weaknesses and exhibit high levels of certain competencies. Bioentrepreneurial competencies are part of scientific/biotechnological skills, life skills as well as managerial skills, which equip the

bioentrepreneur to have a better life and include both occupational /vocational skills and capabilities that enable an individual to make economic gains (Dirisu, 2017). The competencies expected of a Bioentrepreneur will include decision making, creativity and innovation as well as critical thinking, team work and networking. To be able to harness waste resources and convert same into valuable products and or start up cottage industries requires that the Bioentrepreneur be knowledgeable in the product and production process. Such an individual is also expected to be competent in coping with stress and challenges of business. Possessing or developing bioentrepreneurial competencies enables the individual to be able to self-manage, solve problems and understand the biological-based business environment, work well as part of a team in the production process, which always have diverse steps. He or she is also able to manage time and people, and in some cases collaborates with big companies or wealthy company owners to start up, providing the scientific ideas, principles and description of the production process (Olukanni, & Olatunji; 2018; Baron& Shane, 2004; Lehrer &Asakawa, 2004).

Model/Process for Bioentrepreneurship creation

Creating a new Bioentrepreneurship business involves five processes among which is recognizing the opportunity for the product or service, acquiring/securing the intellectual property (IP) right, which may involve licensing; funding, development of the product technology which is based on research as well as also ensuring the survival of the business through additional funding, collaborations etc. The entrepreneur shown in figure 1 is either the inventor of the product/technology or initiator/founder of the business or the one who perceived the market need of the new technology/product and started the business of marketing of the service/product. (Mehta, 2004). The competencies and needs of the bioentrepreneur (either the Technopreneur/scientific entrepreneur or the market perceiver) are summarized in Table 1.

Figure 1. Bioentrepreneurship Model for a Business Start up

Source: Mehta (2004)

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Table 1. Some Competencies Requirements for (Bio)Entrepreneurship Processes

Bioentrepreneurial venture stage	Bioentrepreneur /Technopreneur required competencies
Recognize opportunity	Understanding of expertise in specific, well-characterized technology **(**Intellectual Property, IP)
	Established credibility with peers, investors and customers.
Secure IP rights	A strong position to easily license his/her own invention from the university into the startup and company executive. Need to have an understanding of future IP needs.
Fund team and build company	Strength in early phases of company, where main efforts are on research and most of the personnel are technically oriented.
Develop technology to product	Needs experience of commercial product development, particularly issues in scaling up. Unbiased perspective to evaluate the technology's realistic potential versus its elegance.
Survival	Needs to understand that his or her appropriate position within growing company may not be at the helm, but in a specific technical leadership position or on the Scientific Advisory Board.
Market	Needs to shift focus from developing technology to building a strong commercial team speedily and efficiently.

Adapted from Mehta (2004)

Entrepreneurship Opportunities for the Life sciences

Some (Bio)Entrepreneurship opportunities based on biology or life sciences which people can initiate and start up are listed in Table 2. In all, the scientific principles or theories are applied; hence the bioentrepreneur is well versed with the details of the business.

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Table 2. Diversity of Bioentrepreneurship Venture Opportunities

	Bioentrepreneurship Opportunities	Economic Importance/Value
1	Biofuel (Bioethanol, biogas, biodiesel) production from agro and industrial wastes by microbial fermentation.	Wealth creation by sale of products, Environmental pollution control.
2	Bee keeping	Honey collection for sweetening or as industrial raw materials and also bee wax.
3	Aqua culture	Fish farming. prawn farming and crab culture – protein source
4	Sea Weed Culture and sea weed farming	Products include Agar, Agarose, machines, thickening agents.
5	Floriculture	Growing flowers for ornamental values and for export as well as for domestic market.
6	Horticulture	Growing fruits and vegetable which can be sold in the market local or exported
7	Botanical garden and zoo / animal park	For ecotourism- generates money and for educational research
8	Aquarium	For research and sales.
9	Mushroom Culture	Mushroom are meat substitute and have good export market value
10	Water Conservation	For agriculture and drinking
11	Tree planting.	Preservation of soil fertility and prevention of spreading of the desert; Biological methods are having advantage over the others
12	Poultry farming	rearing birds used for human consumption
13	Bioinsecticide production	To control insect pests in order to increase agricultural yield.
14	Food fermentation e.g. *ogi*, *ogiri*, *dawadawa*, yoghurt	Food preservation, Food fortification with vitamins
15	Serology	Blood typing, diagnostic laboratory services
16	Conservation of medicinal plant	Herbal health products for control of infection and diseases

Adapted from:daSilva et al., (2002); Ejijibe (2012)

Bioentrepreneurial potentials of cassava wastes for Industrial Applications

Cassava wastes, be it solid or liquid is valuable feedstock for industrial production as listed in Table 3. Process technology flow chart is shown in Figure 2.

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Table 3. Composition of Cassava Wastewater and Bioentrepreneurship Potential applications

Cassava waste content	Industrial Application	Reference
Microorganisms	Lactic acid bacteria- Food fermentation	Arotupin (2007) Ebabhi et al (2013)
Organic acid	Lactic acid is used in food preservation	Odunfa (2005)
Amino acid	Lysine	Oboh (2006), Odunfa (2005)
Enzymes'	Amylase, is used as additives for removing starch from textiles, liquefaction of starch	Haki&. Rakshit, (2003) Arotupin (2007)
	Formation of dextrin in baking	
	Preparation of high fructose corn syrup	
	Saccharification of starch for brewing	Aiyer, 2004)
	Cellulase is used for crushing apples to increase yield of juice	Bhat (2000)
	Colour brightener in textile industries	Csizar et al., (2001)
	Making stone wash jean in jeans	Haki&Rakshik (2003)
Peel	Paper making	MohdAripin et al (2013)
Peels, pellet, leave	Poultry feed (birds) and goat feed)	Oboh et al., (2002); Fasuyi (2005); Morgan & Choct (2016); Nwoko et al., (2016)
Peel, wastewater	Bioethanol production	Ohimain (2010), Adelekan (2010); Adiotomre (2015);Nuwamanya et al., (2012), Ezebuiro et al, 2015; Chibuzor et al, (2016).
	Bioremediation of crude oil polluted soil	Akpe et al, (2015).

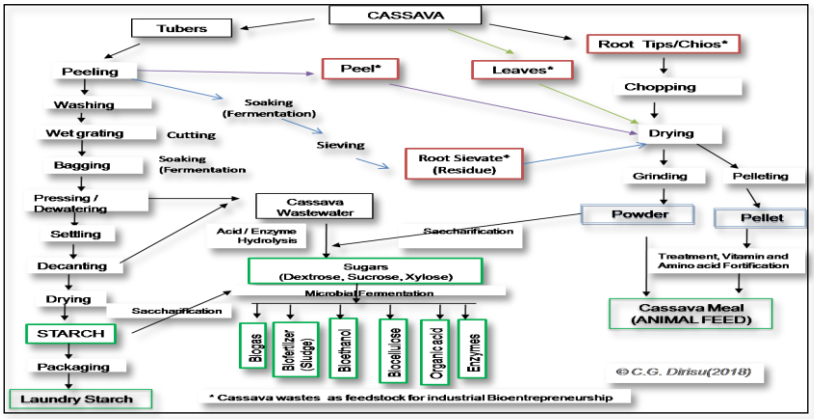

Figure 2. Processing Technologies/Pathway of cassava Wastes generation and Entrepreneurial Potentials (Adapted from various sources)

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Methodology

Study Design

The research design adopted is a survey design and personal interview in order to seek opinions from a defined population on the level of utilization of cassava wastes in selected urban communities in Rivers State.

Study population and Sample

The population of this study covered four communities in four local government areas (LGAs) in Rivers State. These include Omoku in Ogba/Egbema/Ndoni local government area, Ahoada (Ahoada-East). A total of two hundred (200) adult respondents were randomly selected and used for the study. Respondents were distributed as shown in Table 4.

Table 4. Distribution of Respondents (by gender) used for Bioentrepreneurship Competencies and Engagement Survey

Local Government Area(LGA)	Community	No. of Respondents by Sex	
		Male	Female
Ogba/Egbema/Ndoni	Omoku	3	17
	Okwuzi	5	15
	Obite	2	18
Ahoada-East	Ahoada	7	12
Obio-Akpor	Choba	8	22
	Ozuoba	10	21
Emuoha	Elele	9	21
	Emuoha	10	20
	Total	54	146

Source: This Study

A structured questionnaire of 4-point Likert scale study titled, “Level of bioentrepreneurial competencies and industrial engagement questionnaire” (LOBECAIEQ) was developed and used in collecting data for this study. The reliability of the instrument was determined by Cronbach’s Alpha with a reliability coefficient of 0.883, which was rated highly reliable for obtaining information from respondents. Questionnaire was administered and retrieved on the spot through a Research Assistant. Data collected was analyzed using mean to score the responses. Any item in the question with a mean response of $\geq$2.5 was retained or accepted, while any item with mean response $\leq$ 2.5 was not regarded or rejected. Data was analyzed by Pearson’s Product Moment correlation (PPMC) and one way analysis of variance (ANOVA) to determine correlation and significant differences between male and female responses at 0.05 alpha level.

Results

Level of Entrepreneurial competencies for cassava-waste bioconversion technologies

Both gender groups had acceptably high level of competencies (χ>2.5) except for good networking. Females had low lower competency for risk management than male (Figure 3). Male respondents had higher

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competencies for Bioentrepreneurship involving bioconversion of CW into wealth. There was however no significant difference in the level of bioentrepreneurial competencies for both gender groups as indicated by single factor analysis of variance, F(1,16)=0.493,p0.235>0.05 (Table 5). There was also no significant correlation between male and female responses (r=0.845, p>0.05).

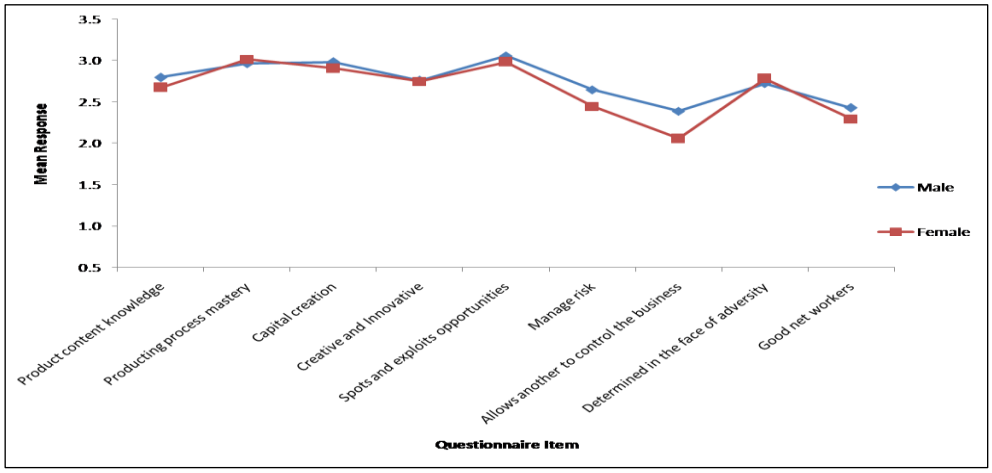

Figure3. Mean Bioentrepreneurial Competencies for Industrial Engagement by Gender

Table 5. One-way Analysis of Variance on Bioentrepreneurial Competencies by Gender

Sources	*SS*	*Df*	*MS*	*F*	*P value*	*F crit*	*RMSSE*	*Omega Sq*
Between Groups	0.0	1.00	0.04017	0.496016	0.49138	4.493998	0.234761	-0.02881
Within Groups	1.3	16.00	0.080985					
Total	1.3	17.00	0.078584					

Level of Entrepreneurial Engagement in cassava waste-based industry among males and females in urban communities

Cumulative mean engagement of females was slightly higher than that of male respondents (ϰ=2.4>2.6). Engagements in higher biotechnological processing had lower mean (<2.5) and hence rejected, which implies that conversion of cassava wastes into such valuable products were done to a small extent. There was no significant differences in both gender responses on bioentrepreneurial engagement in cassava waste based cottage industries, F(1, 14=0.84; p0.37>0.05) (Table 6).

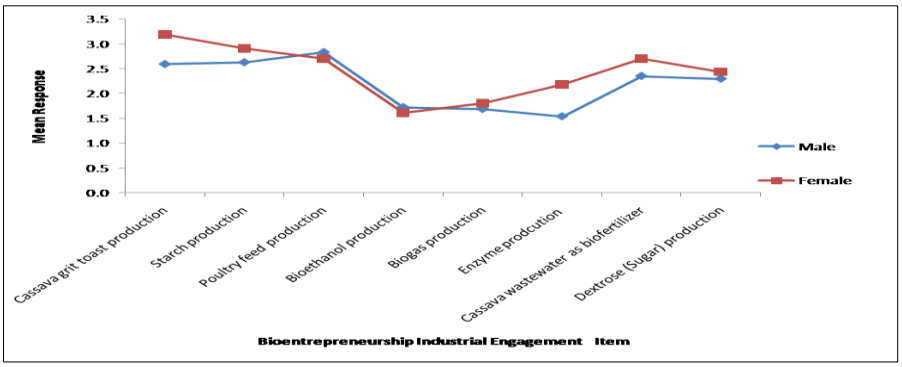

Figure 4. Mean response on Bioentrepreneurship Engagement by gender in cassava waste-based industries

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Table 6. One-way Analysis of Variance on Bioentrepreneurial Engagement by Gender

Sources	*SS*	*df*	*MS*	*F*	*P value*	*F crit*	*RMSSE*	*Omega Sq*
Between Groups	0.227	1	0.227	0.84	0.375	4.60011	0.32	-0.01
Within Groups	3.786	14	0.27					
Total	4.013	15	0.268					

Impact of non-Cassava waste utilization and biotransformation on the environment

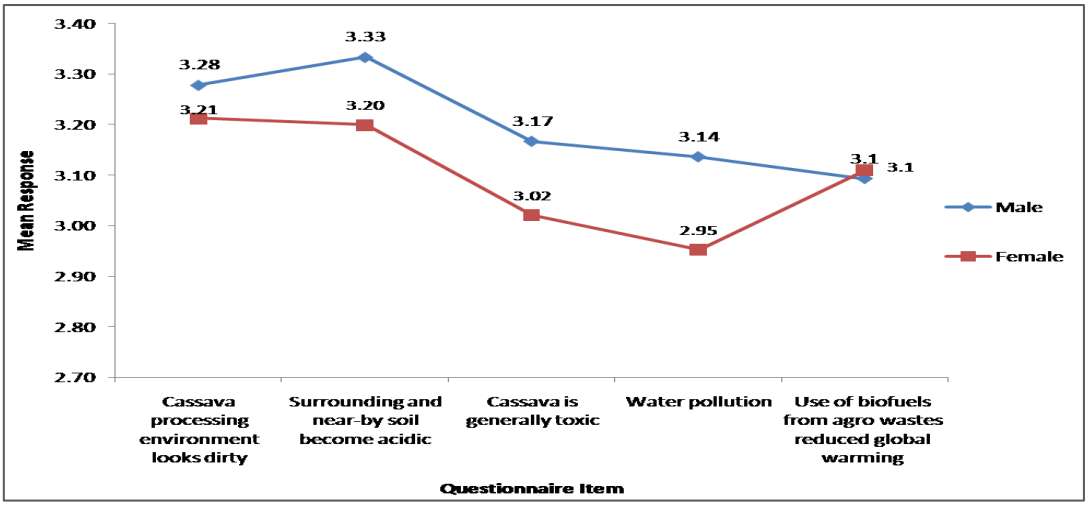

Figure 5. Perceived Environmental Impact of Cassava wastes

Mean responses are well above the cutoff of 2.5, indicating that solid and liquid wastes derived from cassava processing for food were perceived to impact negatively on the environment. Male and females responses were not significantly correlated (r=0.728; t=1.63>0.05). There was also no significant difference in the mean responses by gender in their perceived impacts, F (1, 8) =2.308, p0.17>0.05 (Table 7)

Table 7. ANOVA statistics on perceived environmental Impacts of Cassava Wastes.

Sources	*SS*	*df*	*MS*	*F*	*P value*	*F crit*	*RMSSE*	*Omega Sq*
Between Groups	0.026319	1	0.026319	2.30827	0.167172	5.317655	0.679451	0.115691
Within Groups	0.091217	8	0.011402					
Total	0.117536	9	0.01306					

Constraints to Cassava waste Bioentrepreneurship Engagement in Cottage Industries

Mean responses ranged from 2.0 to 3.2 for males and from 2.0 to 2.9 for females. Among the constraining factors raised, only lack of education was not considered as a factor for low engagement in cassava wastes-based entrepreneurship business (Figure 6). There was significant correlation between male and female in

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their responses (r= 0.98; t(0.006<0.05). ANOVA statistic on mean responses was not significant, F(1,12)-1.557; p0.23>0.05 (Table 8).

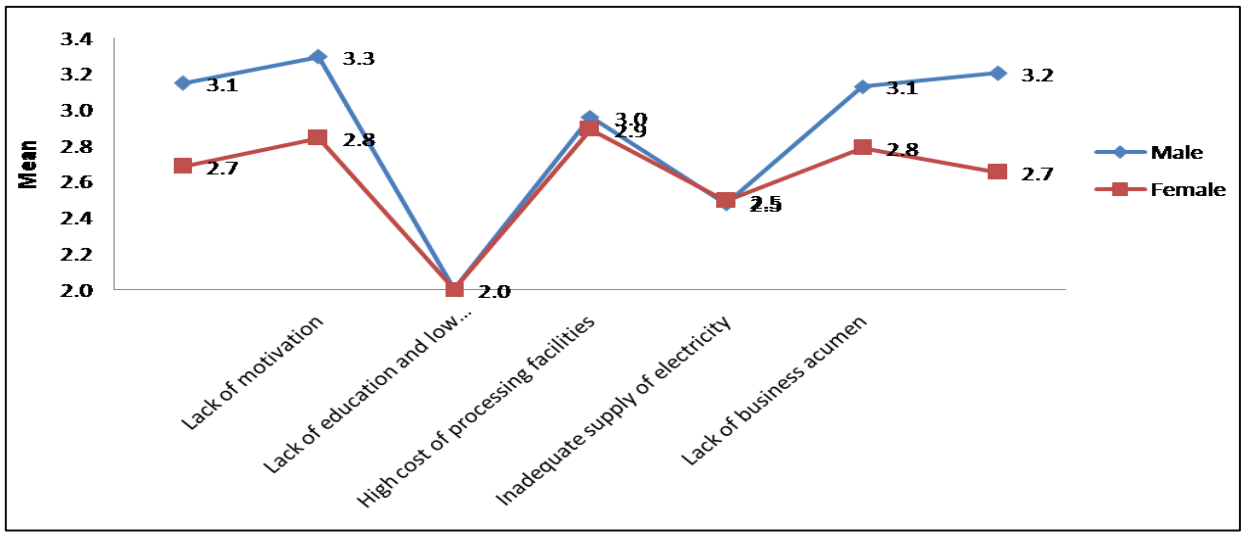

Figure 6. Mean responses of constraints to cassava wastes Bioentrepreneurship engagement

Table 8 ANOVA statistic on mean Bioentrepreneurship engagement constraints by Gender

Sources	*SS*	*df*	*MS*	*F*	*P value*	*F crit*	*RMSSE*	*Omega Sq*
Between Groups	0.248118	1	0.248118	1.557112	0.23589	4.747225	0.47164	0.038271
Within Groups	1.912142	12	0.159345					
Total	2.16026	13	0.166174					

Discussion

Entrepreneurial skills and attitudes provide benefits to humanity, even beyond their application to business activity.According to Ismail et al., (2015), successful entrepreneurship will be achieved if the entrepreneur has vision, is innovative, has passion for the business, able to identify opportunity, create value out of nothing and ensures growth of the business. Competencies relevant to entrepreneurship are creativity and innovation. In Figure 3, bioentrepreneurial competency levels of both male and female respondent ($\bar{x}$>2.5) was not significantly different (Table 5). In most studies, women were more prominent in cassava processing than male adults (Amadi et al., 2019), although they lack the know-how of accessing facilities. According to Ironkwe et al., (2016), agricultural production in Nigeria and especially in Rivers State is yet to reach its potentials due to gender and social inequalities. daSilva et al., (2002) and Ejijibe (2012), posit that establishment of biotechnology farms and commercialization of Biology education could be a means for money and job creation, which is the main essence of entrepreneurship. Akpomi (2008) also maintained that relevant technical and business skills need to be provided to those who choose to be self-employed and/or to start their own venture. Ogbe et al., (2019) affirmed that entrepreneurship has the potential to equip an individual with skills that can help him or her to be self-reliant and ultimately creates employment for others. Dirisu (2017) highlighted some life skills, including problem solving, communication, creativity, critical thinking, decision making as well as coping with stress skills. These skills, no doubt will be of utmost importance for an entrepreneur in relating with people on the business and ensuring its survival.

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Bioentrepreneurial engagement in cassava wastes –based ventures were higher among females than men (Figure 4), although low engagement was observed for businesses involving more biotechnological production involving use of microorganisms and microbiological techniques (χ <2.5). There were higher engagements in starch and feed than biochemicals or biofuel production. This is expected as cassava is a stable food, providing carbohydrate, providing calorie for humans. According to Elias et al (2000) and Hahn & Keyser (2006), cassava is mainly cultivated for food for most people across the world, particularly sub-Saharan African, South America and Asia. In Figure 3, weighted mean score of respondents was below 2.5 and hence rejected, which implies that conversion of cassava wastes into valuable products were done to a small extent. Most people in West Africa see cassava peels and other wastes as materials to be thrown away rather than a potential resource. This is supported by Adebayo et al., (2008),Adelekan (2010) and Ibeto et al (2013).The use of cassava wastes as feedstock for industrial production have been reported for biogas and bioethanol (Olukanni& Olatunji,2018; Ezebuiro et al, 2000; Adesanya et al., 2008; Nuwamanya et al., 2012; Sarker et al., 2012; and Adiotomre, 2015), mushroom production (Oduah et al., 2014), improved animal feed (Morgan & Choct, 2016) as well as biodegradation and bioremediation of crude oil polluted soil (Akpe et al., 2015). (Table 2). Economic situation however, forces some people to use some cassava waste products as food such as starch and cassava grit.The use of cassava peels as animal feed is due to high level of nutrients including carbohydrates (Nwoko et al, 2016). Drying, boiling and fermentation are known to reduce the cyanide content, which is an anti-nutrient compound in the cassava, to non-toxic levels (FAO, 2014; Fasuyi, 2005; Odunfa, 2005; Oboh et al. , 2002).CWW have also been used as biofertilizer by farmers who may not have access to inorganic fertilizersand as herbicides (Ogundo & Liasu, 2007; FAO, 2008). Moreso, enzymes such as amylase and cellulase have been produced from microorganisms, particularly yeasts –*Aspergillus* and *Penicilium*found in starch (Aiyer, 2004; Gupta et al., 2003; Ladeira et al., 2015). Both enzymes have industrial applications in food, fermentation, and pharmaceutical industries as well as detergent industries (Saini et al., 2017; de Souza &Magalhaes, 2010; Arotupin, 2007) (Table 3). In Figure 5, mean score for all items were > 2.5, which implies that cassava wastesimpacted the environment and people negatively to a great extent when improperly managed. According to Smith et al (2001), the disposal of agricultural wastes on land and into water bodies are common, among local processers and have been of serous ecological and health hazards.Cassava is known for its high levels of cyanogenic glucosides (Ngiki et al., 2014), which is responsible for its toxicity (Oti, 2002; Fasuyi, 2005). Unsustainable disposal results in the pollution of both water and land resources, increasein rodents and insect vector diseases thereby creating public health concerns. Besides not getting additional source of income from adding value to cassava peels, heaps of cassava peels or accumulation of CWW affects the aesthetic beauty of the environment with offensive odours in the dump sites. Constraints to non-exploitation of CW is shown in Figure 6. Weighted mean score was above 2.5 even though more respondents rejected the fact that lack of education and inadequate supply of electricity did not affect ability of respondents to convert cassava wastes into valuable products. Other constraints such as poor scientific and technical expertise, lack of professional managers and processing equipment as well as poor financial management can hinder engagement in Bioentrepreneurship ventures. These are supported bydaSilva et al., (2002), FAO (2008) and Ejijibe (2015).

Implications of wastes-based Entrepreneurship Engagement on the environment and socio-economic Development

1. Environmental and health protection: Investment in Bioentrepreneurship ventures using agro-industrial wastes or crop residues serve as substrates or feedstock for bioconversion. It does not only ensures that food and economic crops are preserved or conserved, but also enhances environmental integrity by minimizing pollution and hence prevent infections due to their improper disposal promote wellness. Biofuels derived from cassava (and other lignocellulosic wastes) are pollution free and impose little or no environmental threat, cause no climate changes and the by-product of fermentation can be used as animal feedstock.

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2. **Wealth creation and Economic development*:*** *E*ntrepreneurs are key players in the biotechnological or biology-based business culture of any nation, and are involved in creating wealth and job and enhancing economic growth particularly in agriculture, breweries, food and medical and health industries. The profits accrued to Bioentrepreneurs and payments for labour and marketers, machines, raw materials and buildings flow and raise the National Income, which help in improving the peoples' standard of living. It is reported that rural women in Africa for example, Burkina Faso process shea butter and have established direct links in global markets (DaSilva et al., 2002) and in African-Caribbean pacific, women produce

3. Employment *creation:* Bioentrepreneurs create small businesses by employing local or non-school citizens to engage in some or part of the production and sale process with a monthly wage. For example, people are employed in the processes of cassava peeling, washing, grating/grinding, bagging, frying, and sale of final product (garri). For the utilization of cassava wastes or wastewater, people can be hired to source for and collect the wastes or kerbs can be established where residents supply their wastes to the cottage industry and collect rewards or money. The labour intensive nature of small businesses enables them create more jobs than the big businesses.

4. **Improvement in the standard of living***:* The introduction of high quality goods and services has transformed lives of people in both rural and urban communities. The importance of fermented food in health cannot be over-emphasized.

5. Reduction in rural-urban migration*:* Promotion of Bioentrepreneurship will help to reduce rural-urban drift to cities in search of 'white-collar' jobs. This will in turn reduce congestion and high crime incidence, and social vices.

6. Development of local biotechnological base: Globally, indigenous biotechnological development has been evolved by indigenous Bioentrepreneurs. For example, bread making, wine and alcohol production, condiments, enzyme, food additives production started from traditional fermentation processes. This helps in technology transfer for rapid economic growth in the country.

Conclusion

Results of this study indicate that males had higher competencies than females for engaging in Bioentrepreneurial ventures involving cassava wastes industries, while females were more engaged. Conversion of cassava wastes into more biotech product occurred to a small extent. Cassava waste products affect the environment and people negatively, but converting them into useful products minimizes pollution and enhances environmental protection and conservation, besides creating wealth and job opportunities, which enhances the socio-economic wellbeing of the rural-urban population. There were some constraints to conversion of cassava waste products into valuable products.

Recommendations

Based on the results of the study, it is hereby recommended that:

1. Technologies that encourage the utilization of cassava peels for beneficial uses to both human and animal should be popularized by research institutes.
2. Training workshops should also be organized in order to train the cassava processors on the use of cassava peels for the production of mushroom, biogas.
3. Finally, improvement of animal feed through value addition.

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