Chapter One

Writing a Standard Research Proposal

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Abstract

Research proposal writing is an activity that precedes the research process. A research proposal is expected to map out clearly the research an individual wants to conduct and how it must be executed. It is after the approval of the research proposal that the researcher can embark upon the research. However, in order that a proposal is accepted, it must contain the certain needed elements well explained. This paper examines and explains comprehensively the constituents of standard research proposal as well as presents a guideline for writing one.

Keywords

Research, Proposal, Objectives, Gaps, Problem Statement, Design, Data Type

1.1 Introduction

Proposal is a piece of document that details the ideas about the problems a researcher or for that matter what anyone wants to tackle or investigate as well as the comprehensive methods to be designed and used in remedying the identified problem. It offers the sound bases for the rejection or acceptance of for funding and supervision by fund grantors and academic supervisors respectively.

Proposals are classified in two folds: solicited and unsolicited. The solicited proposals are those that are requested via advertisements by funding organizations for the purpose of funding in anticipation of remedying a situation or by universities for the purpose of award a degree via providing information linked to expanding frontiers knowledge or its application for development. However with unsolicited proposal, the researcher or anyone individual with a requisite skills and credentials identifies a problem and draws the attention of would-be beneficiary institutions to it for funding and subsequent execution.

Proposals, whatever the type need to have strong scientific footing or foundation to be acceptable and winnable. In order for a proposal to be winnable and acceptable, it must contain some essential elements. Many students have faint idea about the essential and must have elements in a proposal for their research and how to write it. This paper is thus geared towards guiding students and researchers towards writing effective research proposals.

1.1.1 Problem Statement

Research proposal is the initial document that must submitted for to a potential supervisor for perusal and appraisal before it is approved for executing. It is expected to contain the essential elements needed in any standard proposal and well written out logically and comprehensively manner to reinforce its

understanding. However, most students and would-be research have shallow knowledge on the components of a standard proposal and how to write them out to convey their intended meanings to their respective potential supervisors or funders. This paper is to aid students and would-be researchers to understand the various components involved in standard research proposal writing as well as present a guide to writing same.

1.1.2 Objective of the Paper

The main objective of this paper is to introduce students and would-be researchers to the essential components of a standard proposal and to introduce them to writing same. The paper however seeks to achieve the following specific objectives:

- To list all the components needed in a standard research proposal
- To explain each of the components of a standard research proposal
- To present a guide towards writing a of a standard research proposal
- To distinguish between a research proposal and a business proposal

1.2 Components of a Standard Research Proposal

Research proposals may vary according to the intended uses, either research or business; and the design approaches, whether qualitative or quantitative. However, whatever the intended uses or design approaches, the essential components remains the same but with slight variations or exclusions in the proposal write-up. It is also extremely important to logically arrange these components in the write up in order to enhance the comprehensiveness of the proposal. The following are the components of a student research proposal arranged logically:

- The title page
- Introduction / background
- Problem statement
- Research questions / hypothesis (note required for business proposal)
- Objective
- Significance / justification / rationale
- Preliminary literature (note required for a business proposal)
- Theoretical framework (note required for a business proposal)
- Methodology
- Budget
- Organization of study (note required for a business proposal)
- Timelines
- Limitations
- Conclusion
- References

(A) The Title Page

The title page though not an essential component in a research proposal cannot be omitted a research write up. It captures the title of the proposed topic and the name of the researcher or students. It should be noted that the research topics should not be lengthy or convoluted or windy. It should be short and precise and unambiguous.

(B) The Introduction or Background of Research Proposal

The introduction or background is the first essential component of a proposal as it is expected to introduce or give the reader the background of the study in order to situate the study in its proper perspective and context. It therefore entails the following:

- The general information on the background
- Specific information on the background
- Identification of a gap in the background information
- Raising appropriate questions about the identified gap
- Providing the a scientific answers to the raised question about identified gap / the thesis statement

The General Information on the Background

This part of the background concentrates on the general scope of the study. It takes into consideration information that has a general link with the topic understudy. For instance if it has to do with composting, the general information can look at the general definition of composting; its use as waste management and how it compares with the other known waste management techniques; its disadvantages and the uses of the final products derived from the process. This presents a general idea on the topic and more importantly it should be arranged logically in its write out.

The Specific Information on the Background

The specific information on the background narrows the information and brings the chosen topic to focus. It presents materials that specifically relate the topic and forms the basis of the study. For instance, if it the topic is on “Appraisal

of Composting as a Waste Management Technique", the student or researcher must concentrate on the strength and weaknesses of the composting as a waste management techniques vis-à-vis the other know waste management techniques as well as highlight known methods of appraising on which the appraisal can be based on.

Identification of Gaps in the Background Information

This is the basis of the study and presents or advances an argument for a scientific or intellectual discourse. It is said that one needs to identify a problem before finding a solution to it and not vice-versa. This portion points out the gaps available in the presented information captured in the specific information background. For instance, as regard the topic on composting stated earlier, though it is the regarded as the most environmentally friendly organic waste management method and its product beneficial for enriching the soil as an organic fertilizer, when used immaturely, can serve an entry of zoonotic and pathogenic microbes into the food chain to pose health hazards and threats to the public. This identified gap can stimulate the debate for the study.

Raising Appropriate Questions about the Identified Gap

Once the researcher or student has identified a gap in the study, it is incumbent on him or her to raise all the necessary questions whose answers are expected to be antidotes for bridging the identified gaps. "How can the survived zoonotic and pathogenic microbes be eliminated in the final compost? What composting method can be used to achieve pathogenic-free compost?"

Providing the a Scientific Answer to the Raised Question about Identified Gap / the Thesis Statement

This is where the researcher or students provide an interim answer to the raised

questions though has not conducted the experiment which is referred to as the thesis statement. For the question raised, the thesis statement that can be made is "There is a method of composting that can be used to achieve pathogenic-free compost".

(C) Problem Statement

The problem statement is the second essential component that must be included in a research proposal. It captures the 'problem' identified in the study concisely and precisely. Normally it should not be a mere observation but a comparison and contrast of observations. When it is left as a mere observation, it is regarded as a weak statement. It must have a structure and sequence.

Structure

In terms of structure, it means it must be superimposed on a defined structure such as idealism part, realism part and a link-up of idealism and realism part:

The Idealism Part

This part presents the ideal situation of the case. It looks at the perfect situation should all conditions remain constant. This presents the perfect way the situation needs to be addressed. For instance, in the case achieving pathogenic free compost. The idealism part of the problem focuses on the fact that all composting techniques or methods are expected to yield pathogenic-free compost.

The Realism Part

This portion presents the real situation at hand and raises the fact that the composting techniques are unable to yield pathogenic-free compost as expected.

Link-up of the Idealism and Realism Part

This is where both the idealism and realism parts are linked and gaps that exist or existed between the two are stated as the problem.

Sequence

This suggests the ordering of the structure in order to build the logic between the parts: idealism –realism – the link-up between the idealism and realism part, to enable that the problem statement comes out logically.

Using the problem statement of this paper for instance:

- It should be changed to "Research proposal is an initial document that must be submitted to a
- “Research proposal is an initial document that must be submitted to a potential supervisor for perusal, appraisal and approval before executing. It is expected to contain the essential elements of conducting or carrying out the intended research study and also serve as a 'manual or guide' for the execution of the an intended research study. It thus must confound to standards required in any standard research proposal writing” - *Idealism Part*
- “However, most students and would-be researchers have shallow knowledge in the components of a standard proposal and how to write them out meaningful proposals for the perusal and subsequent approval of their prospective potential supervisors or funders.” - *Realism Part*
- “This paper is to aid students and would-be researchers to understand the various components involved in standard research proposal writing as well as serve as a guide towards writing a good research proposal.”- Link up between Idealism and realism or bridging up the gap between idealism and realism.

(D) Research Questions / Hypothesis

Research Questions

This is third component where the necessary research questions relating whose answers when found are likely to lead to the solving of the identified problem. Answers need to be provided to all the research questions raised at the end of the research. The answers also must lead to achieving the stated objectives of the study. The research questions raised here are often open ended questions but can yield numerical data. Therefore the data that can emanate from these questions can be either qualitative or quantitative. So in a study where only qualitative data or a blend of quantitative and qualitative data is expected, the research questions can be raised in place of the hypothesis.

Hypothesis

A hypothesis is a scientific guess or statement a research hazards with the aim of designing an experiment to collect data to test whether it is valid or invalid based on evidence presented by the data collected. A hypothesis is expected to be tested once it has been stated in order to help the research reject or fail to reject it. It thus follows the positivist's approach where mathematics or statistics is used to present objective view of the situation at hand. In order to test the hypothesis, it presupposes that all quantitative approaches should be used such that all qualitative variables are converted to quantitative data to enable the testing of the hypothesis. It should be noted that most responses of open ended questions on a questionnaire are classified as qualitative while the responses to closed ended questions are considered as quantitative.

The hypothesis is supposed to be woven from the research questions is thus the research interim answer provided to the research question until proven at the end of the study to be either valid or invalid.

Hypothesis statement is in two folds:

Null hypothesis (H_O): the statement that captures the general situation

Alternate hypothesis (H_1): the claim of the researcher which is the converse of the null *hypothesis*

Stating of Hypothesis

Null hypothesis (H_O): over speeding wastes fuel

Alternate hypothesis (H_1): over speeding does not waste fuel

(E) Objective of the study

The objective of the study can be captured in two ways. The overall objective, also referred to as the main objective can be captured first and subsequently the specific objectives of the study. For instance, as regard the composting title, main objective of the study could be "to appraise the various composting techniques in terms of their ability to eliminate pathogens". The specific objectives are those that when achieved will help the realization the main objective. These objectives are supposed to be numbered and stated in an action oriented manner.

In the case of a student admitted into Bachelor of Mechanical Engineering Programme for instance, his or her main aim will be to come out or graduate as a mechanical engineer. However, to achieve this main objective, the following specific objectives must be achieved:

1. To pass all semester courses
2. To pass the project work
3. To pay all fees required

The research objectives stated should be measurable and attainable.

(F) Significance / Justification / Rationale

The justification of the study is actually the reason or rationale behind the embarking on the study. In the selection of football players for a match, there is a popular parlance used by coaches and lay people alike "justify your inclusion". This means that the researcher needs to justify the need for the study. The justification of the study can be done in the following ways:

The magnitude of the area or coverage of the study

Once the study has large area of coverage, it is likely to affect so many people, objects or areas of study and so becomes vital for examination.

The gaps in literature that demands attention

Where there is little or no literature on the identified gap or the literature available points out the fact that a further work must be done vis-à-vis the gap has been identified. This can be used to justify the need for the study.

The improved or unusual approach / methodology being employed

When researcher proposes an improved method or a new or an unusual of tackling the study, it can also serve as a basis for the study.

The expected benefits or outcomes

The expected benefits or outcomes to be derived from undertaken the study can be used to justify the need for it.

(G) Preliminary Literature

Literature review is one of the areas that must be done extensively for one to

know the historical antecedence of the problem to be tackled. This will make the research up beat with the current trend of events as regard the problem.

For a proposal the one needs to do a preliminary literature review that is not extensive relates the problem as on hand. The researcher in doing a preliminary literature will only need to compare works or studies that have been done relating to the proposed study. It is supposed to be summarized and the authors duly cited.

The Theoretical Framework

This is where the researcher outlines the various theories that underpins his or her work and uses them to describe the models and concepts been used for the study. In research proposal writing, this aspect is supposed to be brief but theories must be exhaustive with the all relevant theories cited.

(H) Methodology

The methodology encapsulates the approaches to be employed in the execution of the study and this must be very well established and written clearly to eliminate all forms ambiguities. Basically the methodology entails the following:

Materials

This lists out the materials to be used for the study or for the design and construction of a system for the study. If various materials are to be used, the composition of all the materials needed for the study or the design and construction of the system must be stated.

Area of Study / Description of the System

This gives a brief description of the area of study in terms of place and the topic area.

The Research design

This is the map out of how the research will carry out the study. It entails deciding whether a qualitative or a quantitative research approach will be adopted based on the variables or data to be collected to achieve the objectives of the study and how that will be done; the sample size to be considered; the sampling technique to be used; the instrument for the data collection; how the data will be analyzed and interpreted based on the test the data has been subjected.

Design type to be employed

The research must state whether a qualitative or quantitative or both designs will be used for the study as per the variables to be measured. For instance, research questions raised are used instead of hypotheses, the blend of qualitative and quantitative research design method must be used but if the hypotheses are used, then the design must employ a quantitative design approach.

Population and Sample Size

The researcher must indicate the population being studied and the size that will be selected as sample. The sample and size selected must be reflective and representative of the population so that it can be used to make inferences about it.

Sampling Technique

The appropriate sampling techniques to be used must be stated by the researcher. There are various types: probability sampling techniques – simple random sampling, systematic sampling, stratified (group) sampling, cluster (area) sampling; non probability sampling – convenience sampling, purposive sampling, judgmental sampling, quota sampling, snowball sampling, intercept sampling. It is thus incumbent on the researcher to select the best sampling technique suited for his or her study. The choice of the researcher therefore depends on his or her

working knowledge of the various probability and non probability sampling techniques listed above.

Probability Sampling Techniques:

They are sampling techniques in which all the objects of the population are given equal chances of being selected.

- Simple random sampling

  This is where random numbers are given to all the objects of the population, bulked together and then selections made at random. In simple words, if the researcher consider studying a population of size of 50 by use selecting a sample size of 25. He or she has to label all the items or elements of the population from one (1) to fifty (50). These numbers can be write on a pieces of paper folded, placed in a cup, shuffled and then the twenty –five of these pieces of paper picked. The numbers picked thus corresponds with the items selected constitutes the sample.

- Systematic sampling

  This is used in selecting samples during a batch production to ensure quality standards of the items. For instance in the brewing industry if Two Hundred (200) cartons of beer are to be brewed a day out of which fifty (50) cartons are to be selected from the total number of cartons (population) in a day to constitute a sample for testing for quality standards. It means that the research is supposed to pick every nth item (in this case carton produced). The nth item is thus defined mathematically as the population size divided by the sample size

$$n^{th} = \frac{Population\ Size}{sample\ size} = \frac{200}{50} = 4$$

This means that to select a sample of 50 cartons of beer from the population of 200 cartons, the research must select every fourth carton (4^{th}) until the 200 cartons is exhausted as it moves along the conveyor.

- Stratified (Group) sampling

  This involves sampling based on grouping (strata) and involves the use of simple random sampling technique. For instance, since there are form one; form two and form three science students; if samples are to be selected from the Science students of Senior High School of a particular school, they are two be selected from all the various forms in order to have a representative sample. In this case random sampling techniques can be used to select equal numbers of science students from each form and then bulked up to form the representative sample as science students of the said school.

- Cluster (Area) sampling

  This involves sampling based on area. For instance if a researcher wants to sample the garages in Accra, he or she can demarcate or zone Accra into four ie. north, south, east and west. From this demarcation or zoning of Accra the research can select equal number of garages which can be bulked up to give a representative sample of garages in Accra.

Non probability Sampling Techniques

These techniques are not based on probability, the objects to be selected using these techniques are not given equal chances of being selected. Thus there biases associated with these techniques.

- Judgemental sampling

  This is where a sample is selected from a population based on the judgement

of the researcher. The basis for the selection is left to the discretion of the researcher. The researcher selects objects that constitute a sample based on what he or she thinks is will best suit or represent the population.

- Quota sampling

  This sampling technique employs the discretion of the researcher. For instance, where the population constitute different object (eg. Persons – males and females of unequal numbers constituting a population), the researcher in constituting his or her sample might use different quota of both gender based. For example in a population of 30 persons consisting of 20 males and 10 females, the researcher can select all the 10 females and 10 males to constitute his or her sample.

- Convenience sampling

  This is where the researcher selects the sample based on convenience. If researcher wants to do a study on polytechnic students in Ghana, once he or she lives in Accra, it will be convenient in terms of proximity to select students from Accra Polytechnic to constitute his sample.

- Purposive sampling

  For this technique of sampling, the researcher bases his or her sample on the purpose of the study. A researcher might want to study people who frequently visit expensive hotels thereby selecting wealthy people to constitute his or her sample.

- Snowballing or Snowball sampling

  This technique is used in selecting a sample in cases where the targeted persons are rare to locate. Since the individuals for selection are rare, once

contact is made with any of the targeted persons, the individual acts as a liaison or an informant to the researcher to help identify persons of characteristics of his or her kind to constitute the sample.

- Intercept sampling

  Intercept sampling is almost like the snowball sampling but in this case, the researcher selects an individual who will locate or intercept the objects or persons to be sampled. It is often used in marketing, where a representative is designated for a region who subsequently locates clients to market the company's items.

It should however be noted that in a research study, two or more sampling technique can be combined in the selection of one's sample depending on the nature and objective of the study.

Instrumentation

This refers to the various instruments the researcher that would be used for the collection of data on the study. In experimental research this can refer to the devices for measuring the various variables being examined for the study. In social research, the questionnaire, interview guide as well as observation method are the basic instruments used for the data collection. These instruments are used for primary data collection. Therefore under the researcher's instrumentation, he or she is to mention the type of instrument that will be used to collect the data and how the chosen instrument will be used to achieve that. Also, researcher can also collect secondary data from reports and papers for desktop analysis.

It must be noted that the choice of the instrument depends the type of design being used for the study. The questionnaire can be used in for both qualitative and quantitative research designs while interview is basically used when the design

adopted for the study is qualitative.

Data Analysis

The data that will be obtained from the experiment are usually at the firsthand raw and therefore meaningless. This is where the researcher must to write on how the collected data will be processed into information. In doing this, the software or application must be stated and the tests that will be subjected to the data also stated. The appropriate statistical test needs to be given based on the design being used. It also encompasses the method that will be used to summarize the results or data. It should however be noted that some statistical tools can be used to summarize qualitative data and others for quantitative data. For instance, the bar chart and pie chart are graphical method used for summarizing qualitative data whereas the histogram, dot plot, scatter diagram, ogive are used for summarizing quantitative data. With tabular methods used in summarizing data, frequency distribution, cumulative frequency tables, relative and percentage frequency distribution and cross tabulation are used for both qualitative and quantitative data. However, the stem-leaf plot is the tabular method is only used for summarizing quantitative data. Sequel to this the researcher must select the appropriate tool based on the data being processed.

Interpretation of Data or Results

Under this heading, the researcher is expected to tell how the results will be interpreted. For instance if has to do with testing of hypotheses, stating how they will be tested and the set criteria for rejecting of failing to reject the null hypothesis and the conclusion to be made either verbally or in mathematical expressions.

(I) Organization of Study

This is where the researcher indicates the way the study is to be organized. It is

expected to indicate the various chapters into which the study will be executed or reported. It supposed to be arranged in a logical sequence, i.e. from introduction in chapter one to the last chapter to be considered. For instance, the researcher might write this under the organization of the study:

The introduction will be captured in chapter one; extensive literature review will be done in chapter three and finally the chapter five will contain the conclusion and recommendations of the study.

(J) Budget

The budget of the study must be captured if the researcher is seeking funding. However if no funding is being sought, then the budget section can be omitted. However for a business proposal, it is essential to include the budget so that the funders can appraise the viability of the proposal.

Below is a sample of a simple student research budget:

Sample of a Simple Student Research Budget

ACT. NO.	ACTIVITIES	ESTIMATED EXPENSES (GH ₵)	REMARKS
1	Proposal Write up and submission for Approval by Supervisor	10	
2	Questionnaire design and administration	40	
3	Data collection	50	
4	Data entry and analysis	50	
5	Report write up	50	
6	Submission of report for correction	-	
7	Correction and Presentation of final report	50	
	Total: 250		

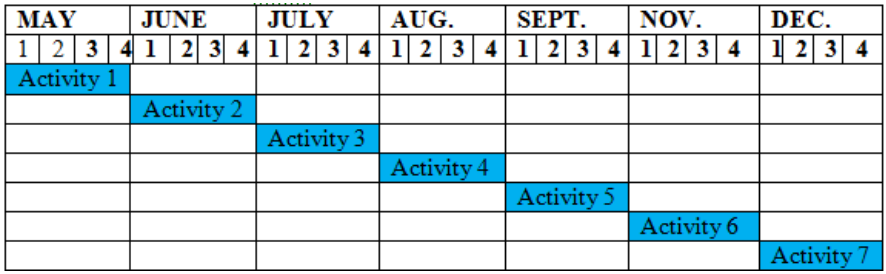
(K) Timelines

The timelines refer to charting the activities together with their schedules as to

when each will be started and when each will be completed. It can be done using the Gantt Chart or a housed in a simple table as done below:

Timelines for the Study

Act. No.	Activities	Duration	Start to Finish
1	Proposal Write up and submission for Approval by Supervisor	One month	May
2	Questionnaire design and administration	One month	June
3	Data collection	One month	July
4	Data entry and analysis	One month	August
5	Report write up	One month	September
6	Submission of report for correction	One month	October
7	Correction and Presentation of final report	One month	December



Gantt Chart for the Study for the Research Study

Note: Refer to the budget for numbers assigned to each activity; the numbers 1 to 4 under each month indicates the weeks in each month.

(L) Limitations

The limitations of the study refer to the constraints that are likely to affect the achieving the objectives of the study. This can be the availability of data to be collected for the study; the time frame allotted for the study; the financial limitations etc. The constraints should be clearly stated before embarking on the study so that the scope of the study can be well defined by it. It will enable the supervisor to know what aspects of the work is likely the researcher or student would not be given attention due to the stated constraints. The limitations are

meant to define clearly the scope of the study.

(M) Conclusion

The conclusion summarizes briefly what is expected to be done and the expected outcome of the study and the intended benefits to be derived.

(N) List of References / Bibliography

Once the researcher worked on the preliminary literature review as well as the theoretical concept or framework, authors or books or articles are expected to be cited in-text and therefore the need for a list of references or bibliography at the end of the proposal.

1.3 A Sample of Academic or Research Proposal

Below are a presentation of two proposals, a research proposal and business proposal respectively:

1.3.1 Research Proposal

Pyrolysis of Coconut Fruit Waste and Packaging Waste Plastics for Energy Generation and Waste Management.

(A) Introduction

Waste is expected to be generated by humans and industries unabated as long as life exists. This is because for human beings to survive, raw materials and finished goods on which they depend must be produced and these leads to the generation of waste. Waste when unmanaged occupies space, creates filth and harbours disease causing organisms which eventually poses threat to human life

apart of creating social nuisance. There are so many waste disposal and management techniques but there is the concerted effort by scientist worldwide to use methods that are more environmentally friendly, can maximize volume reduction, and create wealth via the generation of energy and recovery of useful raw materials beneficial to humans.

Currently the waste management systems being practiced in Ghana include the landfill method, incineration, composting and open burning, aerobic digestion – Composting and anaerobic digestion technique – biogas technology. Though the composting and biogas technology is used for the production of compost and energy generation respectively, they are all limited to management of only organic waste; and waste volume reduction is not zero. Incineration and open burning methods only reduce the waste volume without generating energy and also allow for the pollution of the environment through the emission of green house gases. Coupled with the difficulty of waste separation, these methods are practised on low scale. In Ghana waste management has become a problem with the country recording high perennial filth related diseases such as cholera and malaria. Almost all waste dumping sites are filled and the cost of managing even household waste has hiked up. Sequel to these challenges of waste management, malaria continues to be the number one killer disease in Ghana and there is also an upsurge in cholera cases being recorded in the country because these diseases are filth related.

Pyrolysis, also referred to as thermolysis, gasification, cracking is a thermochemical decomposition of waste (organic and inorganic) to generate useful products such as gas, biofuel, char or activated carbon which can be used as raw materials to propel industrial growth. This waste management method is conspicuously missing as waste management technique in Ghana. This may be due to the lack of the technical expertise in the area or the facilities. That notwithstanding, pyrolysis offers the opportunity for the management of both organic and inorganic waste for energy generation and provision of other useful

raw materials for industries.

Bulk of waste generated in Ghana is made organic waste (65%) and plastic waste (9%) resulting from materials packaging and bottling (Ackah *et al.*, 2012). Organic waste such as the coconut cannot easily be degraded via composting into organic fertilizer and biogas technology for gas generation. In terms of inorganic waste, plastics for packaging of water, food and gifts are predominant, and these cannot be managed by both aerobic and anaerobic digestion. According to Mohana *et al.* (2012) waste plastics also do not biodegrade in landfills and therefore are not easily recycled. For effective management of the country's waste challenges, a suitable waste management technique such as pyrolysis must be studied for its feasibility and effectiveness of being used for the management coconut fruit waste and plastic waste types for energy generation and industrial raw materials production for wealth creation.

(B) Problem Statement

Although waste provides a vital resource for energy generation, effective waste management is a challenge in the country. Bulk of the waste generated in Ghana is organic - food waste, faecal matter and paper waste; and inorganic waste - plastic waste derived from packaging of food, water, drinks and gifts. Landfilling, incineration, composting, biogas technology and landfilling are all waste management methods. However, incineration and open burning produce green house gases that are environmentally unfriendly; composting and biogas technology though are able to generate usable raw materials from waste, are limited to organic waste management. Thus effective management technique for both organic and inorganic waste for generation of energy, biofuel production and other useful raw materials for industries is absent in the scheme of waste management in Ghana. The need to study the use of pyrolysis for managing coconut fruit waste which cannot easily be done using the composting and biogas

technology though organic; and for the management of plastic waste types for energy generation and the production of other raw materials parallel with management of these waste types become vital towards finding a sustainable approach to waste management in the country.

(C) Objectives of Study

The study mainly seeks to use pyrolysis to decompose coconut fruit waste (shell and fibre) which cannot easily be biodegraded; and plastic wastes from packaged food, drinks, food and gifts in order to manage these waste types for energy generation and explore the production of other useful raw materials as well as modeling the use of the pyrolysis process for waste management to enable prediction of its outcomes and cost effectiveness.

The following are some of the specific objectives of the study:

1. To ascertain if coconut fruit waste (shell and fibre) and packaging plastic waste can be managed efficiently through pyrolysis.
2. To estimate the quantum of energy that can be generated on weight basis of feedstock of coconut fruit waste and plastic waste pyrolysed.
3. To find out and estimate the amount of other raw materials that can be produced from the process using the respective feedstock.
4. To model the process in order to predict the feedstock amount that needs to be fed to the system to realize the quantum of each of the products to be generated and the cost of operation.

(D) Research Questions

The study seeks to pose the following research questions:

1. Can the coconut shell and plastic waste be respectively managed efficiently for energy generation through pyrolysis?
2. What quantity of energy can be generated on weight basis of feedstock of coconut shell and plastic waste respectively that undergo pyrolysis?
3. Which other useful raw materials and their respective amounts on weight basis can be produced respectively from pyrolysis of the coconut shell and packaging plastic waste?
4. Can a model on the process be built for prediction of its outcomes and cost effectiveness?
5. Can the pyrolysis of these materials help complement the energy needs of the country?
6. Is the pyrolysis of these materials cost effective?

(E) Hypothesis for the Study

The study would put forward the following hypothesis:

Alternate hypothesis (the claim): A model on the quantum of energy and other useful products generated from the pyrolysis of plastic waste types, coconut fruit waste and their associated cost can be built and used for the prediction and management of the respective waste types.

(F) Justification

Coconut fruit is produced on large quantities in Ghana and its water and meat

sold to workers as snack and some also processed into oil. However, when the water is drunk and meat removed and eaten, the shell, which is part of the endocarp are thrown away. These fruit wastes are often times left uncollected or collected and deposited at landfill sites. Since they are cup-shaped and take time to be degraded, they hold rainwater which becomes stagnant over time and subsequently serve as a breeding ground for mosquitoes, vectors of the malaria parasite. This thus poses health threat to the public because malaria is considered as the number one killer disease in Ghana. Also people often collect and dry these fruit wastes to be burnt for heating. However, this open burning produces smoke which eventually pollutes the environment with green house gases. There is the need to recover energy and other useful raw materials like activated carbon from these waste types alongside managing them to reduce the incidence of filth related disease.

Plastic waste accumulation is ever increasing because of plastic packaging of food, water and gifts. Satchet water and mineral water bottles as well as plastic bags are the predominant waste types which must be managed. There is daily accumulation of large volumes of these waste types in every nook and cranny of the country and this when not managed would gradually destroy agricultural land (because plastics take long time to degrade in the soil) which must be cropped to reverse the threat of food security in Ghana.

Currently, pyrolysis of waste is not being practised in Ghana for waste management and there is no or little data available. Since Ghana has perennial energy crisis, the need to explore the energy generation alongside managing these waste types become necessary. Also the modeling of the pyrolysis process for prediction of feedstocks, the cost of waste management using the pyrolysis process, and the products to be generated would provide literature for further studies.

(G) Related Literature Review

Waste according to (UNEP, 2013) are substances or objects which are disposed or are intended to be disposed or are required to be disposed off by the provisions of national laws. Coconut fruit waste can be classified as a municipal solid waste which is defined as the waste arising from human and animal activities that are normally solid and are discarded as useless or unwanted (Pearvy *et al.*, 1985). The generation of solid waste is on the increase due to rapid rise in population, changing life styles and popularity of fast foods and disposable utensils (Chowdhury *et al.*, 2006). However, limited resources in terms of money, skilled manpower and logistics make it very difficult to handle the bulk volume of solid waste being generated (Edema *et al.*, 2012).

Malaria is by far the leading cause of death in Ghana. Twenty five percent (25%) of children who die before their fifth birthday are killed by the disease, and it claims the lives of many pregnant women too (Asante and Asenso-Okyere, 2003). The cup-shaped like nature of the coconut shells allows rain water to be collected and thus becomes stale over time serving as a breeding environment for mosquitoes. In Ghana, the coir and the shell are mostly burnt openly for the generation of heat for cooking which eventually cause environmental pollution. CO_2 emissions from these open field burning activities accelerate the increase in atmospheric temperature and cause global warming. Due to the health and environmental concerns, many countries have imposed new regulations to restrict field burning activities (Mansaray, 1999).

Instead of biodegradation, plastics waste goes through photo-degradation and turns into plastic dusts which can enter in the food chain and can cause complex health issues to earth habitants (Mohana *et al.*, 2012). It has been estimated that in Accra, plastic waste takes about 16.5% of the waste stream. About two decades now, plastics have become the most favoured materials in the food and

water packaging industry, contributing to an increase in their proportions in the waste stream in Accra (Ackah *et al.*, 2012).

According to Fobil (2001), waste composition studies estimate the percentage of plastics in the waste stream in Ghana at 9%. Littering of plastic bags and other plastic waste is associated with numerous environmental problems such as visual pollution that affects sectors such as tourism; they block gutters and drains creating serious storm water problems and provide breeding place for mosquitoes; they kill when ingested by animals mistakenly for food (Ackah *et al.*, 2012).

Landfilling with plastic waste is not also desirable since plastics take about 20 to 1,000 years to degrade and no economic values will be derived from the waste in that case. The management options for sustainable plastic waste management by recycling, energy recovery, re-use and reduction has its own environmental and socio-economic challenges, since there is no source separation of waste (Ackah *et al.*, 2012).

Several processes and means have been attempted to fight against these alarming levels of waste plastics generation. However each process had its drawbacks in terms of economical, operational and financial limitations for practical implementation. In this contrast, thermochemical process such as pyrolysis can be used to safely convert waste plastics into hydrocarbon fuels that can be used for transportation (Mohana *et al.*, 2012).

1.3.2 Methodology

(A) Materials to be Used

Materials needed for this study would include: a pyrolysis system, feedstocks – coconut fruit waste, packaging plastic waste for food, drinks, water and gifts bags. These waste types identified would be collected for pyrolysis.

(B) Experimental Design

A Randomized Complete Block Design (RCBD) would be used for analysis of this experiment. Coconut fruit waste and plastic waste types for packing of food, water, drinks and gift bags, feedstock for the pyrolysis would serve as the plots or experimental materials in the design for which five (5) levels of the treatment (the five (5) different weights of the waste types measured) would be subjected to and replicated five (5) times in the design. The pyrolysis process would be run on the various experimental materials or plots and measured made on the quantum of energy generated, quantity of any other raw materials produced; and the cost involved in the pyrolysis of each material type determined. Analysis of variance table would be constructed and used to determine whether any significant differences exist between various levels of the treatments on the experimental units.

The obtained data from the experimental units such as the cost involved in running the pyrolysis process; the quantum of energy generated by each waste type; quantity of each raw material produced for each feedstock type and weight used would be used for modeling of the pyrolysis process for the prediction of outcomes and cost effectiveness of pyrolysis process in managing the various waste types.

(C) The Pyrolysis Process

The pyrolysis process would involve subjecting each of the feedstock being considered for the study separately to heat at a temperature of between 400 ℃ – 450 ℃, and sometimes to as high as 800 ℃ in the absence of oxygen, to allow each feedstock to break into smaller molecules of its constituents in the form of gas, oil, solids such as char etc.

Measured weights of each feedstock would be fed into an air-locked or tight compartment where it would be subjected to heat (pyrolysed) at a temperature of

400 ℃ – 450 ℃. The pyrolysis system as shown in the diagram (1) would allow the various constituents such as oil, gas, char, and sludge to flow into different compartments. The oil and vapour undergo fractional condensation. The char would be collected and measured; the pyrolysis oil would be further treated by clarifying, stabilizing, then collected and measured; the hydrocarbon gas would be stored and fired into a flue gases and subsequently made to undergo drying and scrubbing for the clean gas to be obtained and measured. Also, the cost incurred at every stage of the process starting from the collection of the waste together with the cost involved in using a built pyrolysis system for the experiment to the time the feedstock are pyrolysed and the products obtained, tested and measured would be priced.

This process would be run on each of the feedstock being considered for the study separately and the data generated for the process subjected to analysis and interpretation.

(D) Data Analysis

The data collected for the study would be input into enhance Excel and MATLAB application for analysis. The results would be summarized using the appropriate statistical tools, and the data collected on feedstock amount that needs to be fed to the system to realize the quantum of each of the products to be generated and the cost of operation would be used in modeling the pyrolysis process of managing the different waste types.

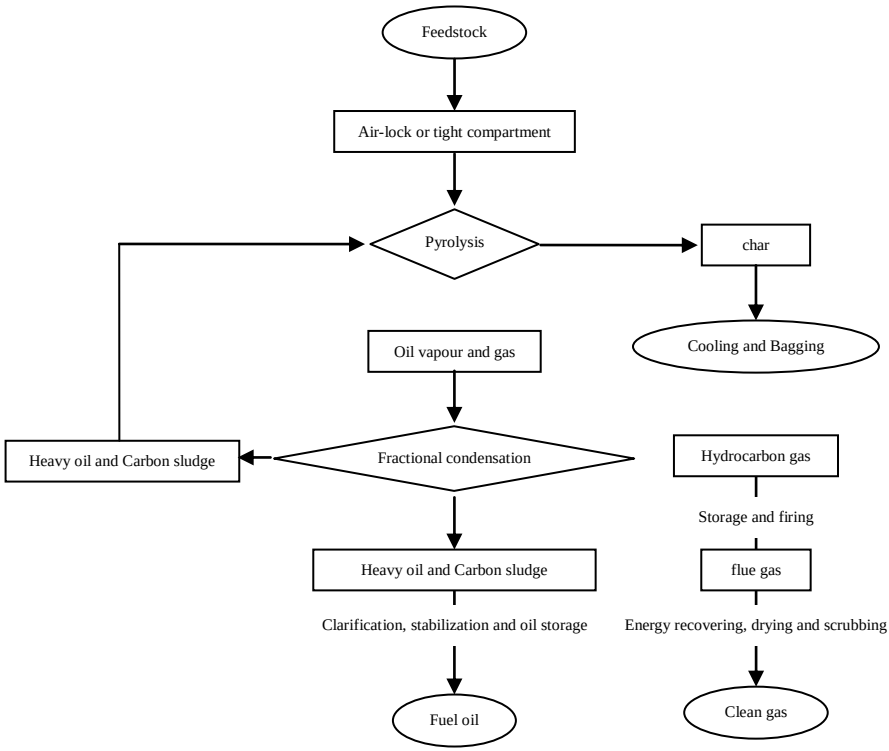


Diagram 1: *Pyrolysis System for pyrolysing the Feedstock.*

(E) Budget for the Study

Activities	Estimated Costs (GH₵)
Collection of the various feedstock for the Design	3000
Transportation of feedstock to Experiment Site	2000
Use of a Built Pyrolysis System for pyrolysing the feedstock	5000
Operating Cost of Pyrolysis on feedstock	3000
Recovery Cost of Products of feedstock	5000
Tests and Regents to be purchased for the identification of derived products	6000
Dissertation write up and articles publication	2000
Total Estimated Cost	26000

*Estimated cost is contingent on the unavailability of pyrolysis system. Availability would drastically reduce cost.

(F) Organization and Timelines for the Research

Activities	Duration	Year
Writing and fine tuning of Proposal	1 month	Semester1, year 1
Identifying sites for the collection of waste types and pyrolysis of waste	1 week	Semester 1, year1
Collecting of waste types and transporting to experimental site	2 month	Semester 1, year 1
Preparing and measuring weights of waste types to be pyrolysed	2 weeks	Semester 1, year 1
Preparing pyrolysis system and running the pyrolysis process on the various feedstock as per the experimental design	8 months	Semester 2, 3 of year 1 and 2
Continuation of the running of the pyrolysis process, recovering, testing and measuring of the process outcome.	12 months	Semester 2, 3, 4 of year 1 and 2
Modelling of pyrolysis process with the data collected	1 month	Semester 5, year 3
Dissertation write up and publications	4- 36months	Semester 2,3,4,5,6 of years 1, 2,3

(G) Limitations for the Study

The availability of equipment for running of the pyrolysis system and the recovery and testing of products obtained from the process are likely to be the major constraints of this study.

(H) Expected Outcomes

At the end of the study the following outcomes are expected to be realized:

1. Come up with a built model for predicting the outcomes and cost effectiveness of pyrolysing the waste types.
2. Establish the cost effectiveness of managing waste (both organic and inorganic) in the country via pyrolysis.
3. Recover energy and other useful raw materials such as biofuel, activated charcoal for industrial and household use for wealth creation from waste.

4. Establish if the energy generated is substantial to complement the energy needs of the country.

5. Appraisal of the pyrolysis system for managing waste and recommend designs and improvement for cost effectiveness.

6. Recommendation on how to reduce waste volumes to prevent filth related diseases (such as cholera, malaria etc) in the country.

7. There would also be research articles published in reputable journals for the dissemination of findings.

(I) Conclusion

At the end of the study, it is envisaged that a model would be built on the use of pyrolysis for management of waste types under consideration which can be used for predicting the quantity of products realized during pyrolysis. The energy and other raw materials expected to be derived from the process can be used as sources of wealth creation and also complement the energy needs of the country aside aiding manage waste to reduce or ward off filth related diseases.

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1.4 A Sample of a Business Proposal

Proposal for Organizing of Remedial Training for the Students Enrolled via the Access Course Arrangement and 'Unqualified' Accra Polytechnic Applicants.

1.4.1 Background

Accra Polytechnic is one of the tertiary institutions in Ghana mandated to teach,

conduct applied market driven research, and provide service to the community – their immediate environ and beyond. Sequel to this mandate, the Institution is to produce well-baked graduate capable of serving as middle level management personnel poised for national development.

Every year the Polytechnic receives large numbers of applications from prospective students seeking admission into the various programmes run in the Institutions. However based on the facilities available and the stipulated minimum entry requirements of obtaining at least C6 in the core subjects (English, Mathematics, Integrated Science and Social Studies) set by the National Accreditation Board (NAB) for students to be admitted into tertiary programmes in Ghana, majority of the applicants are unable to obtain admissions. In the quest to give leverage to students to gain admissions into the HND programmes, the NABPTEX in consultation with the NAB, came up with an access course as a way of bridging the gap, but not a substitute for the WASSCE entry requirements. This presupposes that, all polytechnic students who gain admissions into the system via the access course arrangement will be required in the future to write or meet this inevitable requirement of NAB if they have to further their studies in any of the universities in Ghana. It thus seeks to suggest that the access course arrangement is serving as a respite and not a mitigation of the problem.

This proposal is geared towards creating a platform for the remedial training of the unqualified applicants and those deemed qualified through access arrangement to meet the minimum NAB set entry requirements of obtaining at least C6 in the core subjects (English, Mathematics, Integrated Science and Social Studies) for admission into any tertiary institution in Ghana.

1.4.2 Justification

There is keen competition for tertiary education in Ghana among students. In

recent times, the competition for entry into universities is becoming tougher and keener not only because of the teeming growth in student population but the continual change in the entry requirements for admission of students into the various programmes on offer. The West Africa Senior Secondary Certificate Examination (WASSCE) conducted by the West Africa Examination Council (WAEC) remains the main entry certification aside other known ones like the A-level certification; professional qualifications etc.

However, the WASSCE is the main examination required for entry to the tertiary institutions in Ghana. Matured students and professional students are all required to have satisfied the minimum requirement set by the NAB. NAB quite recently came out with a new requirements to allow students to be admitted into a tertiary programme into any of the tertiary institutions in Ghana with a minimum of grade C6 in their core subjects - English, Mathematics, Integrated Science and Social Studies, depending on the programme offered by the individual at the Senior High School level. It therefore presupposes that any other arrangement that allows an individual entry into any tertiary institutions apart from that of NAB is not national in character and is likely not to stand the test of time. The Polytechnic Access Course is not national in character since the training colleges and the universities could have organized similar arrangements but for their strict adherence to the directives of the authority – NAB. It thus suggests that the Polytechnics are likely to be making themselves an "island" which eventually will limit the progression of their students, if no timely antidote is sought to make all of its students meet the NAB set minimum requirement before their graduation, especially those admitted via the access course arrangement.

Notwithstanding Accra Polytechnic receives many applications from prospective students seeking admission into various programmes, infrastructure and other factors pose limitation to the number of student intake. The lists of the rejected applicants are expunged from the Institution's system with no alternative

arrangements currently put in place by the Polytechnics for the betterment of their grades to enhance their subsequent enrollment into the system for the purpose of creating revenue and jobs for its staff as well as provide service to the public.

1.4.3 Objective

The proposal seeks to achieve the objectives outlined below:

1. To offer remedial training for the writing of WASSCE core subjects by the unqualified applicants who sought admissions from the Institution.
2. To offer remedial training for the writing of WASSCE by students deemed qualified via the access course arrangement.
3. Generation of revenue through teaching of candidates.
4. Creation of employment for the staff or other individuals.
5. Satisfying the set target of NAB to avoid jeopardizing the future of Accra Polytechnic graduates who gain and completed their studies through the access course arrangement.
6. To train and redirect the 'unqualified applicants' for re-admission into the Institution.

Project Execution Procedure

The remedial training shall be organized for students admitted via access course arrangement; Pre-HND students; and the unqualified applicants who sought admission at the Institution.

Students admitted via Access Course Arrangement

Despite the fact that the access course has been started and students have been

given conditional admission, there is a need for a directive to be given by the Institution, that apart from passing the access course which would enable them to be enrolled into the HND programmes, they are expected to meet the minimum entry requirement set by the NAB before they can be awarded their certificate. This caveat must be stated on the admission letters of prospective students to be enrolled via the access course arrangement; and be made to know the Institution's arrangement for their participation in the WASSCE. For students who have already been enrolled and status yet to be confirmed based on their results, the same directive can be communicated to them highlighting in order the consequences of flouting the stated directive.

Pre-HND and Diploma Students

All Pre-HND and Diploma students must be informed on the directive prior to their enrollment into the HND programmes on conditions that the Pre-HND and Diploma examination do not satisfy the NAB set minimum entry requirement for admission of students into tertiary programmes.

The Unqualified Applicants who sought Admission at the Institution

The term ‘unqualified applicants’ here refer to prospecting students who sought admission at the Institution but were not admitted on the ground of not meeting the requirements. Instead of the Institution expunging their names from the system, a platform can be created to offer them remedial training alongside those admitted conditionally via the access course arrangement at a charged fee to allow for their integration into the Institution through re-admission.

The Remedial Training Process

Accra Polytechnic as a way of offering a platform for the remedial training of the students enrolled into the access programme, Pre-HND and Diploma courses

as well as 'unqualified applicants' can come up with a 'Remedial School' within the Institution. This 'Remedial School' set up will be responsible for the enrolment, training and registering of the mentioned categories of students to re-sit their WASSCE in order to enable them meet the minimum set entry requirement by the NAB. If time and space would be a problem, the Institution can hire a space in another institution preferably a secondary school, where top notch teachers or lecturers in the core subject areas will be recruited to train these remedial students. The fees charged students will include: student registration fee; tuition for the subjects registered; course materials; user facilities; and examination registration fees. All students enrolled into the access programme, Pre-HND and Diploma courses within the Institution will be entreated to register.

Duration of Remedial Training

The remedial course training duration must be at least six (6) months before the sitting of the examination and the training is expected to take place once every year at the time WAEC calls for students' registration.

Budget

EXPENDITURE ESTIMATION			
Cost Items	**Number**	**Unit Cost (GH₵)**	**Total Cost (GH₵)**
Design and Printing of Registration Form	2500	1	2,500.00
Printing of Course Materials	2500	25	62,500.00
Call Credits for Calling 'Unqualified applicants'	2500	1	2,500.00
Payment of Teachers / Lecturing Staff	13	6 month @ 2000 per month	117,000.00
WAEC Registration Fees	2500	100 per subject	250,000.00
GRAND TOTAL			434,500.00

REVENUE ESTIMATION			
Revenue Items	**Number**	**Unit Cost (GH₵)**	**Total Cost (GH₵)**
Student Registration Fees and Sales of Forms	2500	50	125,000.00
Tuition for the Subjects Registered	2500	150 / subject and 50 / each extra subject for 6 months	375,000.00
Sales of Course Materials	2500	50	125,000.00
Examination Registration Fees.	2500	200	500,000.00
GRAND TOTAL			1,125,000.00

1.4.4 Cost-Benefit Analysis

ITEM	AMOUNT (GH₵)
Expenditure	434,500.00
Revenue	1,125,000.00
NET PROFIT	690,500.00

1.4.5 Expected Benefits to be Derived from Implementation of the Proposal

The following tangible and intangible benefits are expected to be derived from the Institution of this partnership:

1. Provide remedial training for students admitted into the Institution via access course arrangement, ‘unqualified students who seek admission at the Institution as well as the Pre-HND and Diploma students in order to satisfy the minimum requirements set by NAB.

2. Create employment for teachers / teaching staff.

3. Creation of Internally generated income for the Institution.

4. To provide service to the public by retraining students to meet the requirement needed for admission of students into tertiary institutions in Ghana.

1.4.6 Conclusion

This proposal when implemented will provide the opportunity for the numerous unqualified applicants who are rejected yearly to be retrained for admission into the Institution. It will also offer an antidote to help the students enrolled into the Institution via the access arrangement to achieve the minimum set requirement set by NAB to offer them progression into other analogous institutions in the country. Also, the cost-benefit analysis makes it worth implementing.

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