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Climate Change as an Emerging Component of Project Risk in the Agriculture Sector: An Empirical Assessment

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Abstract

Conditions of climate change are increasingly affecting projects, especially Agriculture projects, across the world. In this situation, climate change could pose a major risk factor in sectors such as the Agriculture sector. This paper empirically examines climate change indicators as a correlated factor of traditional risk factors. A self-reported questionnaire was used to collect data from 265 farmers affiliated to manufacturing organizations in Accra. Factor Analysis (Principal Components) and Pearson's correlation test were used to present findings. We found that all indicators of the traditional and climate change factor produced a communality value of not less than 0.50. Moreover the climatic factor significantly correlates with the traditional factors at 5% significance level. It is therefore concluded that climate change is an emerging component of project risks.

Keywords: project management, projects, project risks, climate change, risk factor, climatic factor

1. Introduction

Project management continues to be one of the most important business functions across all sectors and jurisdictions. Similarly, the number of studies confirming the positive linkage between project management activities and business performance is always on the increase (Ibrahim & Kagara, 2014). In contrast, many organizations might have lost funds, goodwill or market share owing to incidences of project failure encountered by them. Mahendra *et al.* (2013) have also observed that performance and growth issues in many organizations are attributable to the inability to manage projects. By implication, project management can prove futile for an organization when it failure factors are not well hedged.

Several conditions have been pinpointed in the literature as project failure factors. While the list of these factors may be long, poor project risks management or the inability of the organization to identify and control all project risks is one of the most fundamental project failure factors. The idea that poor risks management can lead to project failure is commonplace and is validated by the likelihood of each risk posing adverse effect on the progress or/and quality of deliverables. Though some project risks can be of advantage (Tipili & Ilyasu, 2014; Ojo & Odediran, 2015), the good omen of these risks can hardly be reached (Ojo & Odediran, 2015), a reason why risks management is irrevocable.

Risks management is a project management tradition; an aspect of the Project Management Knowledge (PMBOK) areas that concerns the identification, analysis and control of project risks. It offers the project manager the opportunity to avoid the adverse influence of risks and harness those that can be of merit (Mahendra *et al.*, 2013). Identification of risks, the first stage of risks management, provides the foundation for the project manager to achieve good risks management outcomes. Of course, failure to identify all project risks can be detrimental and implies failure to control some potentially serious ones.

Over the years, researchers (e.g. Tipili & Ilyasu, 2014; Ojo & Odediran, 2015) have given considerable attention to research work relating to project risks management. The worth and depth of the risk management literature has therefore grown for which there is growing knowledge about basic project risks. Human resource, financial, technical and environmental risks are some of the common components of project risks that can be identified in the literature. Some specific sectors and contexts may come with special components of risks or individual risks, and the passing of time leads researchers to new categories of risks (Ekung *et al.*, 2014).

Today's human generation is feeling the heat of climate change. Arguably climate change is causing more harm than humans could have imagined, and its future implications, if not controlled, are enigmatic. The health of humans is not the only resource at the unfavorable grip of climate change – Ojo & Odediran (2015) have acknowledged the potential effects of climate change on project management activities. Some researchers (e.g. Ijigah *et al.*, 2013a) have also acknowledged climate change as a potential project risk factor, especially in sectors such as construction and Agriculture, but the literature has nothing to say about individual indicators of this factor or component. Moreover there is no empirical evidence on how climate change relates to the other risk factors and the extent to which it poses as a project risk factor. As a consequence, researchers and academics may never incorporate climate change as a risk factor into the literature, though it is potentially one of the severest risk factors for some sectors such as Agriculture and Construction, and may as a result undermine project risks posed by it.

In this paper therefore, individual items of the potential climate change risk factor are identified in the Agriculture sector. We attempt to find the extent to which each item and the overall factor can pose as a project risk in the Agriculture sector by drawing information from real-life experiences. The relationship of the climate change risk factor to the basic risk factors in the literature is also examined. We expect this paper to trigger a more intense academic debate on whether or not climate change can introduce new risk concerns in projects, more precisely agro-projects. This paper therefore contributes to the incorporation of climate change into the current framework of project risk factors.

2. Literature Review

Theoretically, every project is characterized by some risks that the project manager must manage. A risk could be defined as the likelihood attached to gaining or loosing something of value. Project risk is defined by the Project Management Institution (2009) as an uncertain condition that, if allowed to occur, has a positive or negative effect on a project's objectives or outcomes. Thus project risks are circumstances that can yield a positive impact on a project, but they are more often than not regarded threats to project success (Hubbard, 2009). The primary and only basis for avoiding the negative impacts of risks and/or earning their positive impact on projects is risks management (Fadun, 2013; Ijigah *et al.,* 2013b).

Risks management is an important or even critical aspect of project management. PMI (2009) identifies it as one of the ten (10) PMBOK® areas that must be necessarily carried out in every project to control all project risks in order to avoid their adverse impact on the project. It is formally defined as identification, assessment, and prioritization of risks, resulting in the mobilization of resources to minimize, monitor, and control the impact of unfortunate events and, if possible, to maximize the realization of opportunities in the project (Antunes & Gonzalez, 2015). So the impact of risks, whether positive or negative, is best influenced by the project manager’s risk management ability.

Risk management has stages that must be effectively managed. These are risk identification, qualitative risk analysis, quantitative risk analysis, risk response and monitoring and controlling risk (PMI, 2009; Ijigah *et al.*, 2013a; Antunes & Gonzalez, 2015). The focal point of this paper is risk identification, which is concerned with gaining sufficiently broad knowledge about risks that can potentially affect project outcomes, good or bad (Hubbard, 2009). Risk identification is the first stage of a risk management process and is commenced before project execution, or before the implementation of project activities, making it possible for all control measures against each risk to be decided and made operational as at the time of project execution.

Project management Institute (2009) identifies the basic way to identify project risks, and this has to do with *experience*; thus the project manager’s experience and that of all other employees and project team members within the organization. The assumption is that the project of interest has been once executed in the organization so that the project manager and other employees should savor past experiences relating to it. Even if the current project is entirely new, the project manager and other employees should know something about it based on their knowledge and experience.

Fortunately risk identification is relatively easy in recent times owing to progressive research work on it. The literature therefore provides evidences on project risks from various perspectives. A major context explains whether project risks are controllable or uncontrollable (Fadun, 2013), with financial risks being some of the controllable risks whereas all or most environmental risks are uncontrollable (Fadun, 2013; Ibrahim & Kagara, 2014). Yet the literature places project risks into some basic categories: (a) financial risks; (b) management risks; (c) technical risks; and (d) environmental risks.

Financial risks are made of financial issues that may influence the course of a project (Hubbard, 2009). Examples of this risk factors are delay in project funds, increase in interest rate on funds obtained through bank lending, poor management of funds, and misappropriation of funds. Management risks are managerial uncertainties that can affect the project (Fadun, 2013). These uncertainties may be constituted by poor management commitment to the project, poor support to the project team, and diversion of management attention to other organizational activities. This category of risks can be correlated to financial risks on the basis of the fact that access to funds by the project team is largely dependent on management activities and management commitment to the project.

Technical risks are uncertainties and issues pertaining to the planning and execution of the project (Ibrahim & Kagara, 2014). This component has elements such as project skills and knowledge of project manager, team members and other employees of the organization, project planning, project execution and PMBOK® areas management capability. This category can also be affected by financial risks on the basis of the fact that poor funding can deprive the project team of resources and needed training, whereas management risks can form the basis of poor funding. Environmental risks are circumstances arising from the physical environment in which the organization exists, including the environment where its projects are executed (Hubbard, 2009; Fadun, 2013). If the organization is located in an environment characterized by difficult economic situations, project funding may be appalled. Hence environmental risks are influenced by management, financial and project risks and affect both the project and the organization directly.

Environmental risks are potentially the broadest component because, as argued by Fadun (2013), they span economic, social, political, legal and climatic conditions of the project and organizational setting. High inflation, exchange rate fluctuation, and interest rate are a few potential economic risks. Social risks include cultural diversity and the influence of humans such as hawkers and crime mongers. Political risks may include political upheaval, instability in government and their effects on industrial regulation. Legal risks could include costly suits and lack of confidence in the justice system.

Climatic conditions have been acknowledged in many studies (e.g. Hubbard, 2009; Ibrahim & Kagara, 2014) as risk factors. Particularly in the construction and agro-processing sectors, climatic conditions and sunshine can pose as risks. Delayed or prolonged rainfall or drought can be a serious risk factor. The seriousness and severity of climatic risk factors are more frightening to think of in recent times of a terrific climate change trend, which has made rainfall and sunshine less predictable. Especially in the agriculture sector, fishing and farming activities are executed against odds attributed to unpredictable rainfall and drought conditions. With the cost of irrigation farming and genetic food modification growing fast by the day, climate change renders the climatic risk factor more enigmatic to governments, organizations and individuals.

The discussion so far suggests that the various components of project risks can be highly correlated. Such correlation can therefore be used to understand how one risk factor changes with another. Yet no study has formally examined the relationship between these risk factors. This study contributes to the literature and knowledge by testing the relationship between traditional risk factors (e.g. financial, management, technical, and socio-economic or environmental risks) and the group of climate change indicators. We argue that it is high time climate change was treated as a distinct project risk factor in some sectors such as the agro-processing sector.

3. Methods and Materials

3.1 Design and Participants

We employed a correlational research design in this study to understand the relationship between pairs of all factors that represent project risks. In addition, our interest in this study was to draw data from the population of individuals who had been engaged in a good number of farming activities or projects for which they must have felt the influence of climate change on their activities. Out target population was therefore constituted by individuals who were affiliated to Ghanaian corporate institutions as farmers and suppliers of agro-products. Ghanaian firms which were in partnership with such farmers are Accra Brewery Limited, Guinness Ghana Brewery Limited, Blue Skies Ghana Limited, Cadbury, Nestle Ghana Limited and Fan Milk. The total number of farmers affiliated to these organizations was 456. However 80 of these farmers disclosed that they could not read and understand English. Moreover 23 of the farmers disclosed that they could not participate for personal reasons. Hence our accessible population was made up of 353 farmers. To be able to detect even weak correlations, we decided to collect data on all members of the accessible population.

3.2 Instruments

We measured project risks using items depicted in the framework of Mahendra et al. (2013). Items in this framework belong to five broad categories of project, which are analysed in this paper as traditional project risk factors. Since items and scales do not exist in the literature for measuring climate change as a project risk factor, we coined variables that we think are the best indicators of climate change impact on agro-projects in Ghana. In essence, we measured five factors, namely traditional project risk factors in the literature (i.e. financial risks, technical risks, management risks, and environmental risks, which include legal risks) and climate change (i.e. climate change risks).

Items of all factors were measured using a self-reported questionnaire using a five-point Likert scale: strongly disagree (1); disagree (2); not sure (3); agree (4) and strongly agree (5). We pre-tested the questionnaire in a pilot study in which 50 of the farmers responded to the questionnaire. The pilot study was used to correct errors in the questionnaire and to verify its reliability. Results reached in analyzing data of the pilot study shows that the reliability of each factor is appreciable and satisfactory. The reliability coefficients or Chronbach alpha values reached are shown in Table 1.

3.3 Analysis

Before questionnaires were administered, we informed each of the organizations to which the farmers were affiliated about the study by formally writing to them. The organizations afterwards provided a list of their contract farmers and their contact details. Farmers were called to inform them of the study and to know if they could participate in it. For the purpose of administering informed consent forms, we arranged to meet those who agreed to participate at the premises of their partner organizations on various dates. After completing the informed consent forms, we asked participants to respond to the questionnaires. Those who could not respond immediately were asked to come back to complete questionnaires on another day. In all 265 questionnaires were completed and returned by respondents, with 21 discarded owing to the fact that they had major response errors in them. Therefore 244 questionnaires were analyzed.

We used SPSS-AMOS to analyze data. Descriptive statistics were used to summarize data and to identify the presence of outliers. Pearson’s correlation test was used to verify the correlation between indicators of the five factors. Factor Analysis (i.e. principal components) was used to examine the dimensionality of all risk factors. Results of data analysis are presented in the next section.

4. Results

4.1 Exploratory

The goal in this section is to analyse data to find out if the climatic factor significantly correlates with one or more of the traditional project management risks. A precursor to the analysis is an assessment of the reliability of the scale used to measure each risk factor. Findings of the reliability assessment are shown in Table 1.

Table 1. Reliability Statistics

Dimension	No. of Items	Chronbach’s Alpha
Financial risks	5	0.693
Management risks	4	0.673
Technical risks	5	0.764
Socio-economic risks	13	0.749
Climatic risks	5	0.783
Total	32	0.720

Table 2. Descriptive Statistics – Indicators

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16
Mean	4.15	4.24	4.28	3.38	3.14	4.20	4.20	3.99	4.11	4.36	3.64	4.30	4.00	4.30	3.60	4.35
Std. Dev.	1.06	0.71	0.97	1.22	1.01	0.68	0.81	0.71	0.70	0.79	0.92	0.78	0.55	0.64	1.12	0.58
Analysis N	244	244	244	244	244	244	244	244	244	244	244	244	244	244	244	244

	V17	V18	V19	V20	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30	V31	V32
Mean	4.55	3.81	3.85	4.55	3.70	3.75	4.41	4.51	3.80	3.96	4.09	2.09	3.59	4.19	4.25	3.90
Std. Dev.	0.50	1.17	0.80	0.50	1.19	1.00	0.58	0.59	1.20	0.92	0.71	1.34	0.93	0.95	0.62	0.95
Analysis N	244	244	244	244	244	244	244	244	244	244	244	244	244	244	244	244

From Table 1, the financial and management risk factors have a reliability coefficient (i.e. Chronbach’s alpha of approximately 0.7, which is the cut-off value recommended by Morse (2002). The other risk factors, including the climatic factor, meet the baseline criterion of producing a coefficient of at least 0.7. Moreover for each factor, no indicator is removed.

Table 2 shows the descriptive statistics of the 32 indicators of the five risk factors in Table 1. The mean scores represent the extent to which respondents agreed that an indicator is part of a project risk factor. The closer the mean estimate is to 5, the higher the level of agreement associated with that indicator. On the other hand indicators with mean scores closer to 1 are not perceived as aspects of project risk factors. Based on these criteria, respondents perceived all variables as indicators of a risk factor, with variables such as V10 (Mean = 4.36; Std. Dev. = 0.79) and V12 (Mean = 4.30; Std. Dev. = 0.78) being the most highly perceived.

Table 3. Correlation Matrix of Indicators

	V1	v2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30	V31	V32
V1	1.00	0.43	0.16	-0.04	0.12	-0.05	0.02	0.07	0.18	0.47	0.05	0.13	-0.18	-0.22	0.52	0.49	0.23	0.15	0.28	0.23	0.09	0.19	0.38	0.20	0.41	0.16	0.33	0.24	0.12	0.33	-0.06	0.22
v2	0.43	1.00	0.72	0.31	0.24	-0.33	-0.10	0.41	-0.06	0.01	-0.11	0.51	-0.14	-0.18	0.59	0.79	0.33	0.19	0.44	0.33	0.52	0.60	-0.01	0.05	0.24	0.08	0.88	0.30	0.33	0.55	-0.16	0.35
V3	0.16	0.72	1.00	0.68	0.47	0.12	0.10	0.52	-0.06	-0.02	0.06	0.42	0.18	-0.24	0.50	0.55	0.19	0.19	0.66	0.08	0.44	0.51	-0.05	-0.02	0.23	0.00	0.71	0.25	0.32	0.52	-0.14	0.65
V4	-0.04	0.31	0.68	1.00	0.31	0.26	-0.05	0.37	-0.12	-0.11	0.19	0.03	-0.01	0.03	0.16	0.16	0.13	0.12	0.54	-0.12	0.22	0.25	-0.17	0.05	0.15	0.10	0.37	-0.08	0.14	0.17	-0.07	0.47
V5	0.12	0.24	0.47	0.31	1.00	0.03	0.38	0.14	0.18	0.06	-0.06	-0.04	0.10	-0.15	0.02	0.52	0.04	0.03	0.34	-0.16	0.00	0.19	0.14	0.04	0.23	-0.11	0.20	-0.04	0.50	0.24	-0.23	0.43
V6	-0.05	-0.33	0.12	0.26	0.03	1.00	0.38	0.20	0.27	0.24	0.37	0.06	0.54	0.10	0.02	-0.20	-0.04	0.16	0.13	-0.19	0.24	0.06	0.42	0.12	0.22	0.34	-0.27	-0.03	-0.21	-0.31	0.36	0.25
V7	0.02	-0.10	0.10	-0.05	0.38	0.38	1.00	0.16	0.75	0.28	0.29	-0.02	0.34	-0.21	-0.08	0.16	-0.03	0.35	0.19	0.22	0.31	0.11	0.57	0.31	0.35	0.35	0.04	0.07	0.10	-0.13	0.20	0.28
V8	0.07	0.41	0.52	0.37	0.14	0.20	0.16	1.00	-0.11	-0.01	0.54	0.45	-0.14	0.00	-0.12	0.37	0.14	0.00	0.27	0.14	0.42	0.43	0.11	-0.13	-0.29	-0.08	0.31	-0.04	-0.07	0.24	0.11	0.22
V9	0.18	-0.06	-0.06	-0.12	0.18	0.27	0.75	-0.11	1.00	0.30	0.05	-0.15	0.12	-0.28	0.04	0.03	-0.02	0.39	0.01	0.13	0.27	0.10	0.52	0.37	0.43	0.47	0.07	0.26	0.14	-0.27	0.29	0.00
V10	0.47	0.01	-0.02	-0.11	0.06	0.24	0.28	-0.01	0.30	1.00	-0.32	0.31	0.11	0.09	0.32	0.28	0.40	-0.03	-0.01	0.27	0.06	-0.02	0.35	0.27	0.13	0.23	0.02	-0.08	-0.21	-0.24	0.12	0.04
V11	0.05	-0.11	0.06	0.19	-0.06	0.37	0.29	0.54	0.05	-0.32	1.00	-0.08	-0.10	0.10	-0.44	-0.17	-0.25	0.06	-0.01	-0.14	0.03	-0.11	0.06	-0.15	-0.07	-0.02	-0.19	0.06	-0.12	0.01	0.16	0.01
V12	0.13	0.51	0.42	0.03	-0.04	0.06	-0.02	0.45	-0.15	0.31	-0.08	1.00	0.11	0.31	0.32	0.56	0.73	0.18	0.17	0.48	0.53	0.24	0.06	0.00	-0.03	-0.06	0.33	-0.02	-0.02	0.28	0.24	0.05
V13	-0.18	-0.14	0.18	-0.01	0.10	0.54	0.34	-0.14	0.12	0.11	-0.10	0.11	1.00	0.00	0.33	0.00	0.00	0.23	0.34	0.18	0.30	0.17	0.31	0.15	0.30	0.29	-0.01	-0.15	-0.11	0.10	0.00	0.49
V14	-0.22	-0.18	-0.24	0.03	-0.15	0.10	-0.21	0.00	-0.28	0.09	0.10	0.31	0.00	1.00	-0.40	-0.03	0.41	0.00	-0.31	-0.06	0.04	-0.28	-0.19	-0.13	-0.19	-0.06	-0.41	-0.33	-0.23	-0.28	0.07	-0.29
V15	0.52	0.59	0.50	0.16	0.02	0.02	-0.08	-0.12	0.04	0.32	-0.44	0.32	0.33	-0.40	1.00	0.47	0.23	0.33	0.56	0.41	0.41	0.51	0.24	0.37	0.61	0.35	0.70	0.26	0.25	0.48	-0.08	0.54
V16	0.49	0.79	0.55	0.16	0.52	-0.20	0.16	0.37	0.03	0.28	-0.17	0.56	0.00	-0.03	0.47	1.00	0.56	0.34	0.45	0.39	0.53	0.60	0.32	0.21	0.32	0.11	0.67	-0.03	0.38	0.45	-0.26	0.44
V17	0.23	0.33	0.19	0.13	0.04	-0.04	-0.03	0.14	-0.02	0.40	-0.25	0.73	0.00	0.41	0.23	0.56	1.00	0.29	0.10	0.40	0.37	0.09	0.11	0.09	0.02	0.06	0.14	-0.37	-0.16	0.11	0.20	0.03
V18	0.15	0.19	0.19	0.12	0.03	0.16	0.35	0.00	0.39	-0.03	0.06	0.18	0.23	0.00	0.33	0.34	0.29	1.00	0.51	0.29	0.64	0.56	0.56	0.65	0.72	0.64	0.39	0.08	0.34	0.14	-0.14	0.53
V19	0.28	0.44	0.66	0.54	0.34	0.13	0.19	0.27	0.01	-0.01	-0.01	0.17	0.34	-0.31	0.56	0.45	0.10	0.51	1.00	0.35	0.54	0.65	0.44	0.47	0.54	0.32	0.66	0.11	0.39	0.53	-0.23	0.85
V20	0.23	0.33	0.08	-0.12	-0.16	-0.19	0.22	0.14	0.13	0.27	-0.14	0.48	0.18	-0.06	0.41	0.39	0.40	0.29	0.35	1.00	0.54	0.29	0.28	0.26	0.27	0.17	0.42	-0.08	0.16	0.52	0.20	0.13
V21	0.09	0.52	0.44	0.22	0.00	0.24	0.31	0.42	0.27	0.06	0.03	0.53	0.30	0.04	0.41	0.53	0.37	0.64	0.54	0.54	1.00	0.75	0.53	0.35	0.45	0.43	0.58	0.12	0.27	0.29	0.16	0.42
V22	0.19	0.60	0.51	0.25	0.19	0.06	0.11	0.43	0.10	-0.02	-0.11	0.24	0.17	-0.28	0.51	0.60	0.09	0.56	0.65	0.29	0.75	1.00	0.51	0.46	0.42	0.52	0.76	0.10	0.34	0.34	-0.23	0.66
V23	0.38	-0.01	-0.05	-0.17	0.14	0.42	0.57	0.11	0.52	0.35	0.06	0.06	0.31	-0.19	0.24	0.32	0.11	0.56	0.44	0.28	0.53	0.51	1.00	0.59	0.54	0.60	0.13	0.07	0.10	-0.06	0.14	0.42
V24	0.20	0.05	-0.02	0.05	0.04	0.12	0.31	-0.13	0.37	0.27	-0.15	0.00	0.15	-0.13	0.37	0.21	0.09	0.65	0.47	0.26	0.35	0.46	0.59	1.00	0.63	0.78	0.35	-0.13	0.18	-0.10	-0.06	0.44
V25	0.41	0.24	0.23	0.15	0.23	0.22	0.35	-0.29	0.43	0.13	-0.07	-0.03	0.30	-0.19	0.61	0.32	0.02	0.72	0.54	0.27	0.45	0.42	0.54	0.63	1.00	0.61	0.44	0.32	0.56	0.26	-0.07	0.55
V26	0.16	0.08	0.00	0.10	-0.11	0.34	0.35	-0.08	0.47	0.23	-0.02	-0.06	0.29	-0.06	0.35	0.11	0.06	0.64	0.32	0.17	0.43	0.52	0.60	0.78	0.61	1.00	0.30	0.00	-0.10	-0.23	0.12	0.44
V27	0.33	0.88	0.71	0.37	0.20	-0.27	0.04	0.31	0.07	0.02	-0.19	0.33	-0.01	-0.41	0.70	0.67	0.14	0.39	0.66	0.42	0.58	0.76	0.13	0.35	0.44	0.30	1.00	0.32	0.46	0.52	-0.30	0.54
V28	0.24	0.30	0.25	-0.08	-0.04	-0.03	0.07	-0.04	0.26	-0.08	0.06	-0.02	-0.15	-0.33	0.26	-0.03	-0.37	0.08	0.11	-0.08	0.12	0.10	0.07	-0.13	0.32	0.00	0.32	1.00	0.41	0.11	0.02	0.00
V29	0.12	0.33	0.32	0.14	0.50	-0.21	0.10	-0.07	0.14	-0.21	-0.12	-0.02	-0.11	-0.23	0.25	0.38	-0.16	0.34	0.39	0.16	0.27	0.34	0.10	0.18	0.56	-0.10	0.46	0.41	1.00	0.45	-0.36	0.24
V30	0.33	0.55	0.52	0.17	0.24	-0.31	-0.13	0.24	-0.27	-0.24	0.01	0.28	0.10	-0.28	0.48	0.45	0.11	0.14	0.53	0.52	0.29	0.34	-0.06	-0.10	0.26	-0.23	0.52	0.11	0.45	1.00	-0.10	0.44
V31	-0.06	-0.16	-0.14	-0.07	-0.23	0.36	0.20	0.11	0.29	0.12	0.16	0.24	0.00	0.07	-0.08	-0.26	0.20	-0.14	-0.23	0.20	0.16	-0.23	0.14	-0.06	-0.07	0.12	-0.30	0.02	-0.36	-0.10	1.00	-0.30
V32	0.22	0.35	0.65	0.47	0.43	0.25	0.28	0.22	0.00	0.04	0.01	0.05	0.49	-0.29	0.54	0.44	0.03	0.53	0.85	0.13	0.42	0.66	0.42	0.44	0.55	0.44	0.54	0.00	0.24	0.44	-0.30	1.00

Table 4. Extraction Values

	V1	v2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30	V31	V32
Initial	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Extraction	0.97	0.92	0.97	0.77	0.93	0.89	0.90	0.96	0.87	0.85	0.93	0.88	0.86	0.85	0.98	0.93	0.88	0.88	0.85	0.82	0.92	0.88	0.83	0.81	0.97	0.90	0.96	0.84	0.87	0.94	0.67	0.93

4.2 Results

Table 3 shows the correlation matrix of the 32 items of the risk factors. It can be observed that most pairs of the variables produced considerable correlation coefficient. Examples are V_1 and V_2 (R = 0.43); V_3 and V_8 (R = 0.52); and V_2 and V_{15} (R = 059). This evidence suggests the likelihood of risk factors being correlated with the climatic condition. Yet a related but more robust evidence is provided in Table 4, which contains the communalities of the PCA.

Table 5. Correlation Matrix of Factors

		F1	F2	F3	F4	F5
	R	1	.577**	.162*	-.103	.551**
Climatic risks (F1)	Sig. (2-tailed)		.000	.011	.109	.000
	N	244	244	244	244	244
	R	.577**	1	.232**	.127*	.499**
Financial risks (F2)	Sig. (2-tailed)	.000		.000	.047	.000
	N	244	244	244	244	244
	R	.162*	.232**	1	.461**	.347**
Management risks (F3)	Sig. (2-tailed)	.011	.000		.000	.000
	N	244	244	244	244	244
	R	-.103	.127*	.461**	1	.198**
Technical risks (F4)	Sig. (2-tailed)	.109	.047	.000		.002
	N	244	244	244	244	244
	R	.551**	.499**	.347**	.198**	1
Socio-economic risks (F5)	Sig. (2-tailed)	.000	.000	.000	.002	
	N	244	244	244	244	244

**. Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed)

Communalities are measures of the variance shared by individual indicators with the underlying risk factor. The larger the communality value, the more attached the indicator is to the underlying factor (Ringner, 2008). From this viewpoint, indicators of largest communality values are more strongly attached to the underlying factor. A baseline value for retaining an indicator as part of the underlying factor is 0.5 (Tipping & Bishop, 1999). In Table 4, all 32 indictors have a communality value greater than this baseline value. The last five indicators (i.e. V_{28}, V_{29}, V_{30}, V_{31} and V_{32}), which make up the climatic factor, also have communalities significantly larger than 0.5. By implication, the climatic indicators are sufficiently related to the traditional indicators. This finding can be confirmed in the correlation matrix of risk factors shown in Table 5. Though the relationship between the climatic factor and technical factor is not significant at 5% significance level (R = -.103, p = 0.109), this outcome is attributable to the relatively small sample size of the study.

Table 6. Risk Factors and their Indicators

Factor	Symbol	Indicators
	V1	Lack of credit facilities to farmers
	V2	High interest rates on loans
Financial risks	V3	Inability to meet criteria of borrowing from financial institutions
	V4	Funds are not readily available
	V5	Availability of funds is delayed
	V6	Inconveniences created by management of partner organizations
Management	V7	Indecision in farming activities
	V8	Unavailability of labor
	V9	Negative attitudes of laborers and workers
	V10	Lack of knowledge on modern methods of farming
	V11	Low or poor awareness on modern inputs and equipment
Technical	V12	Lack of awareness of new government policies
	V13	Lack of awareness on how to approach each farming season
	V14	Lack of awareness on how to approach each farming project
	V15	High interest rates
	V16	High exchange rate fluctuation
	V17	High inflation
	V18	Taxes paid
	V19	Poor government involvement
	V20	Social instability
Socio-economic	V21	Lack of government's recognition for the informal sector
	V22	Political instability
	V23	Difficulty with land tenure system
	V24	Bush burning
	V25	Desertification
	V26	Human activities such as theft and encroachment
	V27	Cultural influences (e.g. beliefs that restrict farmers from acquiring some portions of fertile land)
	V28	Instability in rainfall patterns
	V29	Prolonged drought
Climatic	V30	Delayed rainfall
	V31	Unpredictable weather conditions
	V32	Changes in climatic conditions

Findings thus indicate that the climatic factor, which is represented by indicators of climate change, are sufficiently correlated with the traditional project risk factors. This finding suggests that climate change indicators can influence the traditional factors and their indicators. Secondly the climatic risk factor is retained as a valid co-risk factor of project risks in the agro processing sector in Ghana. Table 6 shows indicators that make up each risk factor.

The retention of the traditional risk factors is consistent with several studies (e.g. Ekung *et al.,* 2015; Ibrahim & Kagara, 2014). Moreover by virtue of retaining the traditional factors, PMI's (2009) theoretical framework of risk management is supported. Invariably findings of this paper support PMI's (2009) identification of some conditions encountered in a project as risks that can affect project performance. While there is no identifiable study that has empirically examined the climatic factor, its retention in the PCA implies that it is an individual component of project risks.

5. Conclusion

The traditional project risk factors (e.g. financial, management, technical, and environmental risks) have all been retained in the Principal Component Analysis as risks associated with projects in the agro processing sector in Ghana. The new climatic dimension is also retained as a project risk factor in the agro processing sector. On the basis of findings reached in the PCA, items of the five risks factors found share a significant amount of variance (i.e. not less than 0.50), for which they act collectively as project risk factors.

Moreover, the five factors reached are significantly correlated so that a change in one factor can be influenced by other factors or can influence other factors. This relationship is stronger for the climatic*financial factor pair and climatic socio-economic factor pair. It is therefore concluded that the climatic factor is significantly related to the traditional factors for which it needs to be considered an emerging project risk factor.

6. Implications for Research

To reiterate, the climatic risk factor is made up of risk indicators of climate change. Therefore in view of its retention with the traditional factor the PCA, it ought to be treated as a project risk factor in this study's population. Similarly, this factor is a potential component of project risks in other sectors and regions. Future researchers are therefore expected to capture this factor, either using the same or similar items, when assessing project risk factors and their effect on projects.

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