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# Assessing the Impact of Heat on Health and Productivity among Nigerian Farmers: A Review of Literature

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**ABSTRACT**

The purpose of this study is to review the impact of heat on health and productivity on agricultural workers, which to especially focused on the Nigerian farmers. First the phenomenon of climate change and how it affects human health is discussed on global perspective and Nigeria to be specific. The review focuses on heat stress and its symptoms on farmers working under the condition of high temperature and how these symptoms affect health and productivity. It further examines the physiological changes of the human body due to heat stress and the thermal comfort zone in accordance to the human stress index. Findings have shown that agricultural field workers exposed to high temperature resulted in heat stress related symptoms such as; heat cramp, exhaustion, syncope and even heat stroke.

**Keywords:** *Heat Stress, thermal comfort, Health, Productivity.*

## 1. Introduction

Climate change is one of the greatest threat facing the globe. This is because it causes rise in the ambient temperature of our environment (UNEP, 2010). According to IPCC (2013), the global average surface temperature show a warming of about $0.85^0$C over the period of 1880 to 2012. Additionally, with the continued emission of greenhouse gases at year 2000 levels a further warming of about $1^0$C per decade would be expected. The world Meteorological Organization (2015), reported that 2011-2015 have been the warmest five year period on record with many extreme weather events especially heat waves which is influenced by climate change. Tropical climatic zones, with normal daytime air temperatures exceeding 30°C, consist of about 40% developing countries (Costello & Abbas, 2009). Nigeria which is in the tropics is one of the developing countries in Sub-Saharan Africa, has recorded an increase of $1.1^0$C in its mean ambient air temperature from 1901 to 2005 (Peter, 2010) Agriculture is among the major employer in the developing world, farming operations carried by farmers is normally at high risk of heat stress, as they work under high pressure, perform extended hours of work in high heat and humidity, suffer dehydration and often do not have sufficient knowledge on the prevention of heat exposed (Schenker, 2011). Nigerian farmers are mostly peasant by nature and spend many hours under intense sunlight in almost all the farming operations, most of the time using local tools (Yisa, 2005). Thus, they engage themselves in heavy work which requires much energy under a hot environment, thereby increasing their chances of generating more body heat that may subsequently result in heat stress or its related

In addition, heat stress may also lead to reduction in task productivity which normally results in their lowered manual dexterity and adjusting for a more comfortable environment (Parson, 2013). Therefore, this study will critically review the existing literatures on heat stress and productivity in relation to agricultural workers in these tropical countries.

# 2. Materials and Method

The method used in generating information for this study is through the review of different scholarly article on the subject. Information was sourced from books, journals and other scholarly articles. Searches were made mostly using literature data bases such as; Google scholar, Science Direct e-journals, PubMed and google search engine.

Search words related to the subject were used such as 'effect of heat on health and productivity', 'effect of heat stress agricultural workers' 'heat stress and symptoms', 'heat stress and occupational exposure', 'impact of heat on Nigerian farmers'.

# 3. Results and Discussion

## 3.1. Causes of Heat Stress

Heat stress and related illnesses is basically caused by exposure to high temperature and, the most serious of which is heat stroke (Conti, 2011). In addition, heat stress can also be developed through intense physical activity, high humid-ity and lack of air movement. Children, elderly and those with poor medical condition are at increased risk. (Nag et. al., 2009).

## 3.2. Heat Stress among Nigerian Farmers

According to Yisa (2005), peasant farmers cultivate 80 percent of the food consumed by Nigerians. In addition, about 86 percent of the land cultivation in Nigeria uses hoes, cutlasses and other local tools throughout the farming oper-ations (Oyedemi & Oladije, 2002). Consequently, the use of these local tools may result to discomfort and injuries (Fathallah et. al., 2008). These problems combined with heat stress on the Nigerian farmers can lead to reduction in work efficiency and productivity and even threaten survival (Shapiro & Epstein, 1984). This implies that the majority of Nigerian farmers engage in intense physical activity and therefore susceptible to the health risk of heat exposure.

## 3.3 Effect of Heat Stress on Health

Exposure to heat renders people to undergo thermal strain that may affect their health, comfort and performance. This may even lead to death especially when the weather becomes very hot, usually among vulnerable people (elderly, children, people who are ill or with disabilities,). This is because the thermal strain imposed by heat stress, such as increased heart rate, body temperature and respiratory problems is often beyond the capacity of the vulnerable person to cope (Parsons, 2013). The effect is more evident among people working in low and middle-income tropical countries, given that majority of them engage in intense physical activity normally under strong sunlight or indoors without proper cooling. The combination of high work in-tensity simultaneously with high heat exposure can result to serious health effect such as heat stroke and even death (Kjellstrom et al. 2009).

A healthy human body is expected to maintain a core body temperature of 370C, given that temperature of few degrees higher that this can result to the body systems mal-functioning (Bridger, 2008). The body always works to maintain this core body temperature even in extreme condition when the external air is greater than 370C. The mechanisms rely basically on sweating, which is less efficient as the relative humidity increases. (Kjellstrom et al. 2009). The World Health Organization (1969) made a conclusion that core body temperature should not exceed 38°C (100.4°F) or for oral temperature to exceed 37.5°C (99.5°F) in prolonged daily exposure to heavy work and/or heat. In addition, NIOSH (1986) declared that deep body temperature of 39°C (102.2°F) should be considered as a reason to terminate exposure even when deep body temperature is being monitored. Furthermore, as the core body temperature rise above its set limit of 370C, skin blood flow increases initiating sweating. There is an increased risk of heat exhaustion when the core body temperature reaches 38-390C, and beyond that heat stroke can occur with an eventual failure of the central nervous thermoregulatory system (Kampmann et. al., 2011). The heat stress risk is potentially greater for occupational workers that engage in activity, because the elevated level of metabolism requires a greater amount of heat to be dissipated in order to attain heat balance (Ollie & Glen, 2010).

## 3.4 Heat Stress Related Symptoms and illness

The most common heat stress illnesses are heat cramps, exhaustion, syncope, and heat stroke. Heat cramp is the spasm of the muscle that can occur on set during or after working hours (Parsons, 2013). This due to the electrolyte imbalances in the exercising muscle and/or dehydration, normally accompanied with high physical labour in a hot environment. (NIOSH, 2002). Heat exhaustion is the most common response to prolonged exposure of high outdoor temperature resulting from salt or water depletion (Leon & Gordon, 2011). The risk of heat exhaustion starts when the core body temperature is between 38-390C (Jay & Kanny, 2010). This condition can progress to heat stroke if unrec-ognized and treated (Ebi, 2011). This condition is charac-terized by heavy sweating, paleness, muscle cramps, tired-ness, vomiting, fast and weak pulse with shallow breathing, weakness, vertigo, headache, nausea, and peripheral vascular collapse (Conti, 2011).

The most detrimental of all is heat stroke which is cause due to severe heat stress and occur when the body is inca-pable of thermoregulation, normally at or above 400C (Conti, 2011). Been a life threatening condition characterized by rise in core body temperature, hot dry flushed skin and central nervous system dysfunction, its symptoms ranges from headache, fainting, seizures, confusion, vertigo, hallucina-tions, delirium, and possibly coma (Leon & Gordon, 2011). Many of heat stroke reported deaths have been associated with occupational exposure at construction sites, agricultural settings, and hot industrial jobs requiring heavy work (Lundgren, Kuklane, Chuansi, & Holmer, 2012).

### 3.5 Effect of Heat Stress on Productivity

Thermal condition is a basic factor in determining op-timal productivity, in particular during physically demanding work (Lloyd, 1994). According to Fisk (2000) 7% increase in work productivity is recorded at temperatures of 20-240C. While on the contrast, productivity is affected after about an hour of moderate physical work in temperatures above 32°C (Bell, et. al., 2001). Humans always seek for a more thermal comfort environment unconditionally by reducing physical activity when faced with heat stress during work, in order to reduce body's internal heat production. As a result the hourly work capacity is reduced and thus economic productivity is also at stake. Worker's action to prevent ill health will lower productivity and a loss of daylight work hours will occur (Lundgren et. al., 2012). Thermal environments may affect physiological and psychological processes, which may affect performance at tasks, thus interact with other factors to affect overall productivity (Parsons, 2013). According to Ramsey (1995) decrement in performance can occur around the temperature of 30-330C WBGT.

### 3.6 Relationship between Heat Stress and Physiological Body Changes

There are many physiological responses to an increase in heat stress. These can constitute: reactive (acute) re-sponses, relating to the body's coping mechanisms in im-mediate response to exposure; or adaptive, reflecting an adjustment of physiological systems to continued (chronic) heat exposure and forming the basis of the process of adaptation or acclimatization (Graveling et al., 1988). According to ACGIH (1992), individual heat stress exposure should be discontinued when heart rate is in the excess of 180bpm sustained over several minutes or recovery heart rate at 1 minute exceeds 110bpm.

Recommendation has been made for heart rate to be measured after the work has ended and 110 bpm is consid-ered high (NIOSH, 1986). Observations have shown that heart rate is high at air temperatures of 31-350C than at 28-300C (Sahu et al., 2013). Core body temperature and blood pressure are seen to be increasing whenever work progresses (American Heart Association, 2015). ACGIH (1992), suggested individual heat stress exposure should be stopped when core body temperature rises to 380C for un-acclimatized person and greater than 38.50C for medically fit acclimatized persons.

## 5. Conclusion

Heat stress affects human health and productivity whenever the body temperature rises above 380C. This is caused as a result of exposure to high temperature and hu-midity, intense physical activity and poor medical condition. The health impact of heat stress ranges from heat cramps, syncope, exhaustion and heat stroke. In addition, productivity is also reduced greatly when work is done under higher temperature.

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