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HIV/AIDS AND RYMV INFECTION COMPLEX: IMPLICATION FOR NUTRITION AND SUSTAINABLE RICE PRODUCTION IN SUB-SAHARAN AFRICA

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ABSTRACT

In sub-Saharan Africa (SSA), especially, West Africa, rice is the single largest source of calories in the diet of low income groups. In 2003, rice provided daily 342 kcal per capita compared to 277 kcal from millet, 275 kcal from sorghum, 247 from cassava and 216 kcal from maize. Agriculture, nutrition and human health are interlinked in many ways. Human Immunodeficiency Virus (HIV) causes AIDS disease in human, while rice yellow mottle virus (RYMV) is a devastating disease in rice for which farmers in French speaking countries of West Africa 'Sida du riz' meaning AIDS of rice. HIV/AIDS is a world wide pandemic, with 70% infected person living in SSA, while RYMV is restricted to African rice fields. The diseases are both devastating and infectious and are of economic significance to nutrition and rice productivity. This paper highlight the nature of the viruses, effects, management practices and the implication of the combined effects on nutrition and rice productivity in SSA and its consequences on smallholder, resource poor rice farming families.

Keywords: HIV/AIDS, RYMV, Nutrition, Rice production, sub-Saharan Africa

INTRODUCTION

Rice Yellow Mottle Virus (RYMV) is endemic to Africa and in most cases present in newlyestablished, large-scale, irrigated rice fields and/orexperimental fields of Asian exotic varieties. Control of RYMV is difficult because the virus is highly infectious and the epidemiology and role of vectorsare not wellunderstood. In his editorial message in the SPORE, April-May, 2011, the Director general of Technical Center for Rural Cooperation (CTA), Michael Hailu summaries the interlink between agricultural productivity, nutrition and individuals' health when he said 'agriculture, nutrition and health are interlinked in many important ways. Agriculture produces the food that provides the calories and micronutrients essential for a healthy and productive life. In turn, the health conditions of farmers and laborers profoundly affected agricultural productivity'. In sub-Saharan Africa, especially, West Africa, rice is the single largest source of calories in consumers' diet. In 2003, rice consumption in West Africa provided daily 342 kcal per capita compared to 277 kcal from millet, 275 kcal from sorghum, 247 from cassava and 216 kcal from maize (FAOSTAT data base). Therefore, any significant shift in the supply of rice will have significant effect on the nutrition, food security and welfare of the resource poor households. This was brought to fore at the Abuja Food Security Summit, organized by the Africa Union in 2006, when it conferred on rice the status of 'regional strategic commodity' for sustainable food security in Africa. But this dream is threatened by the combined effects of HIV/AIDS and *Rice Yellow Mottle Virus* (RYMV).The Human Immunodeficiency Virus (HIV) is retrovirus that causes Acquired Immune Deficiency Syndrome (AIDS) disease in humans, while RYMV is one of the most devastating viral diseases of rainfed lowland and irrigated rice in sub-Saharan Africa (Yvonne *et al*., 1999; Abo, 2004; BrightSurf, 2007). Farmers in Cote d'Ivoire and other French speaking countries of West Africa call the disease '*Sida du riz'* meaning AIDS of rice. It is endemic to Africa, having first been identified in Kenya in 1966. While almost all of SSA countries have generalized HIV epidemic- that is their national HIV prevalence rate is greater than 1% (UNAIDS, 2010a, 2010b).

Relationship between HIV/Aids and RYMV

Both HIV/AIDS and RYMV are infectious and are of economic importance to both nutrition and sustainable rice production. The HIV/AIDS epidemic has continuous to have a devastating effect on

sub-Saharan Africa and the majority of the population who are affected by or infected with HIV/AIDS are mainly small-holder farmers, whose agricultural skill are vital to the continued survival of the traditional agriculture through out the sub-continent (CABI, 2005).

Food security and nutrition has been threatened by some endemic problems, like drought, political conflicts and poor agricultural inputs and technology in Africa for decades, complicated by a combination of factors like devastating effect of RYMV and more recently by the impact of HIV/AIDS. The interaction between HIV/AIDS pandemic and the devastating effect of RYMV forms a complex web and are inextricably interrelated, affecting nutrition and rice production in the sub-continent and therefore offering management challenges to both public and private managers of strategic health delivery system and sustainable food production and security.

Several research reports (Donahue & Williamson, 1999; Lorey, 2000; USAID, 2004; Castleman *et al.,* 2004; Egounlety, 2006) point to the fact that lack of proper nutrition increases the risk of HIV transmission from mother to child and the progression of the infection. Malnutrition also increase fatigue and it decrease physical activities and work productivity of people living with HIV/AIDS. While, RYMV leads to yellowing, mottling, and stunting of infected plants with narrowing of emerging leaves and incomplete emergence of the panicle with subsequently sterile or unfilled grains. When infection occurs early in plant development the plant normally dies resulting in total crop loss.

Sub-Saharan Africa has been worst hit by the HIV/AIDS and RYMV pandemics, accounting for approximately 70% of the world's HIV/AIDS cases (USAIDS, 2010a, 2010b) (Fig. 1), and reducing yield in susceptible lowland rice by 97% - 100% and as high as 54% in tolerant upland cultivars respectively (Fomba, 1988; Abo, 2004).

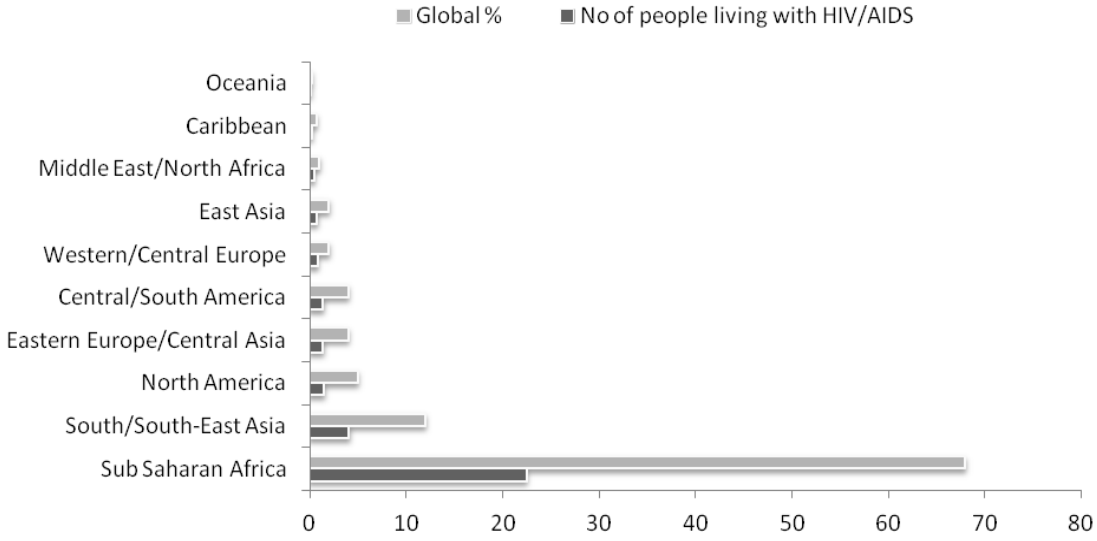

Fig. 1. Number of people living with HIV/AIDS in each region of the World in 2009 (Sources: UNAIDS, 2010a)

While HIV/AIDS is described as the devastating pandemic in human history (Awake, 2001), million of hectares of lowland and irrigated rice fields are potentially at risk from RYMV pandemic in sub Saharan Africa (WARDA, 2000). They affect every facet of the society and rice production. When a rice field is infested by RYMV and the family is also stroked by HIV/AIDS, the result is catastrophic.

This paper is an attempt to bring together the complex issues surrounding both HIV/AIDS and RYMV in relation to nutrition and sustainable rice production in sub Saharan Africa with the main aim of outlining the complex web formed between the two challenging factors in increased rice production and to stimulate policy makers working in these areas.

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The Nature of the Viruses

Viruses are sub-microscopic infective entities that multiply intracellarly and are potentially pathogenic. A virus is smaller than bacterium, which in turn, is much smaller than the average human cell. The HIV is so small that 230 million particle of them would fit on the period at the end of this sentence (Awake, 2001). It is classified as retrovirus and belongs to a specific sub-group known as lentiviruses because it can be latent for a long period before serious symptoms of disease become manifest.

When HIV gains entry into a human cell, it is able to use the cell's metabolic mechanism to further its own cause. It re-programmed the DNA of the cell to replicate itself several times. But before it can do this, HIV must use different codes. It must change its RNA to DNA so that it can be read and understood by the cell's machinery. To successfully do this, it employs a vital enzyme called reverse transcriptase. After producing several thousands of new HIV particles, the cell dies and a newly produced HIV virus infects other cells and the cycle is repeated. Once the number of the helper T-lymphatic cells has dropped significantly, other forces can overrun the body without much resistance. The body then succumbs to all sorts of opportunistic infections and diseases. At this stage, the individual has advanced to full blown AIDS. The food and agricultural organization (FAO) of the United Nations estimated that in most affected African countries; AIDS has killed seven million agricultural workers since 1985, and could kill 16 million more within the next 20 years (FAO, 2003) and therefore, reduce agricultural production by 20-24% in some endemic countries (Fig. 2).

However, as with other viruses, individual levels of tolerance to the virus vary considerably. This depends on factors such as strain variant of the virus, physiological and psychological state of the infected individual and the nutritional status of the person involved (Abo, 2004). The initial symptoms of AIDS are not specific and therefore, phases of infection are characterized by the presence or absences illness: asymptomatic and symptomatic phases. During the asymptomatic phase, no visible disease symptoms are shown on the individual's body, but during the latter stage, major sign and symptoms related to AIDS are pronounced.

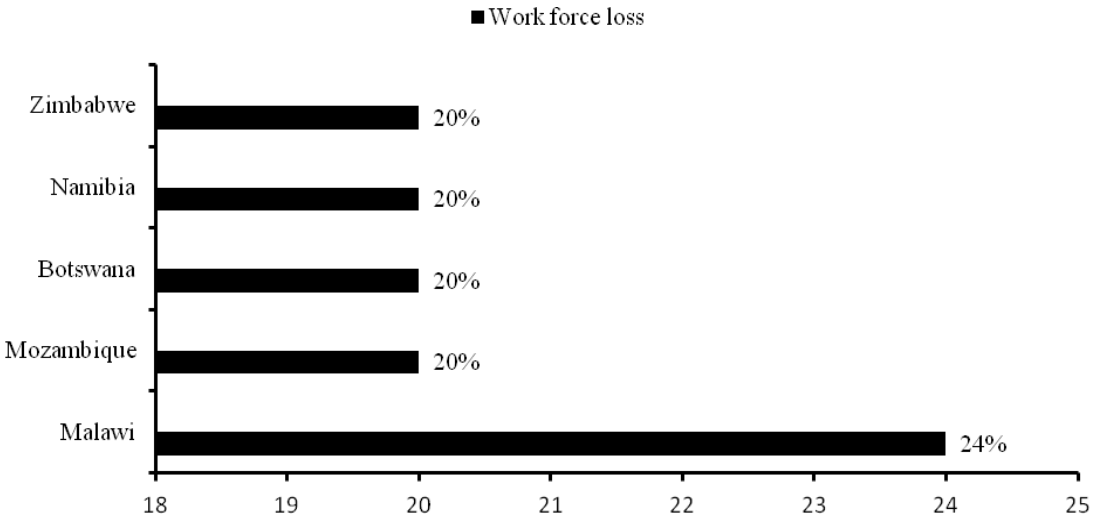

Fig. 2. Shrinking in agricultural workforce due to HIV/AIDS in some endemic counries in sub-Saharan Africa (Sources: UNAIDS, 2010b)

During the past few decades, the HIV/AIDS pandemic has engaged the mental and physical resources of the top medical investigators around the globe, which has entailed large financial expenditures at the expenses of the provision of social amenities, agricultural input for input dependent improved crop varieties, and general economic development. The immediate impacts of HIV/AIDS is on the small agricultural farm holders are well documented and include poverty, food insecurity, and poor nutrition,

farm labor deficits, losses in household income, gender inequalities, rising dependency burden, stigmatization, loss of essential skills, increases demand for medical care, and time loss (Fig. 3) among others (FAO, 1995; Topouzis & Hemrich, 1996; Alumira, 2006; Tunji, 2006; Oluwatayo, 2007).

The RYMV virus is very stable, highly infectious, unpredictable in appearance and destructive to rain fed lowland and irrigated lowland rice. farmers in Cote d'Ivoire called the disease '*Sida du riz'* meaning AIDS of rice because of its destructive and devastating nature on their rice crop thereby forcing them to abandon their farmlands with resulting high crop losses. Although, RYMV is restricted to Africa and its adjourning islands (Abo, 2006), it does not pose serious threat to the rice fields of Asia, which represent 90% of the world production and consumption.

There are four principal characteristics of the RYMV infection on rice plants: yellow mottling of the leaves, stunted growth, reduced panicle exertion, and panicle sterility (WARDA, 2000). Like in HIV infection, RYMV affect several metabolic apparatus of the rice plants. Chlorophyll is reduced and therefore results in reduced photosynthesis, reduced plant growth and development.

HIV/AIDS, RYMV, Nutrition and Rice Production: Interactions Complex

The relationship between HIV/AIDS, RYMV, and nutrition and rice production is complex and multidimensional (Fig. 3). While HIV/AIDS undermines household's ability to provide for their basic needs, rice production is diminished when HIV/AIDS infected adults cannot work and rice production and/or earning decrease. Rice production is labor intensive and the labor requirement reduces from upland ecology through hydromorphic to lowland area. While rice farming families infected by HIV/AID moved from labor intensive, high productive lowland ecology to upland area where yield is significantly low compared to the former (Fig. 4).

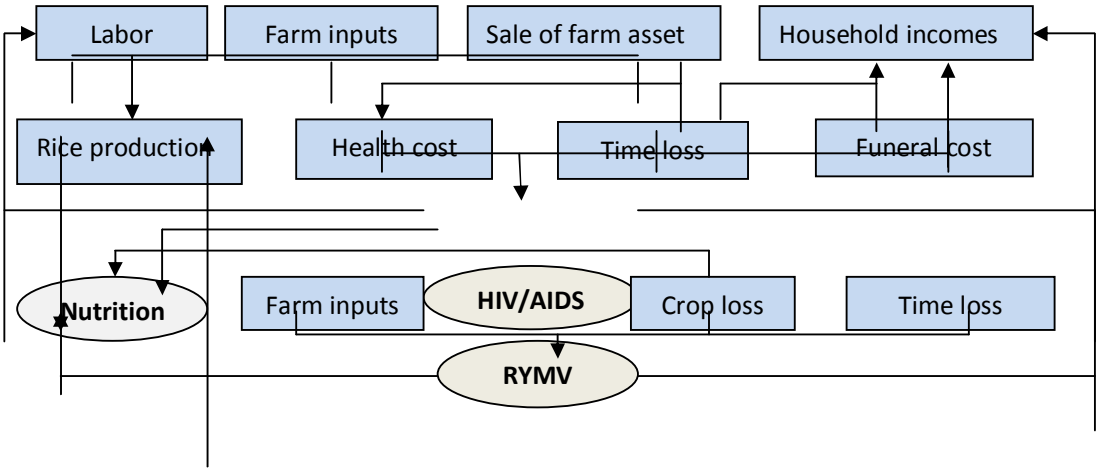

Fig.3. A model to help visualize the impact of HIV/AIDS and RYMV complex on Nutrition and rice production at small farm holders' level

The Food and Agricultural Organization (FAO) of the United Nations has estimated that seven million agricultural workers have died of AIDS and related diseases worldwide (Abo, 2004). This has lead to the reduction of available labor for farm operations and subsequently reduction in rice cultivated area, shift to less labor-or cash-intensive ecology and crops, and depletion of nutrition (Fig. 2).

Rice provides nutrition and livelihood to several thousands of people in SSA. When RYMV infect rice fields, the result is devastating and has great consequence on the intensification of rice cultivation, nutrition, household food security and livelihood. The relationship between HIV/AIDS and RYMV may be viewed from two directions: biological and socio-economic perspectives. Biologically, research has shown that the chances of infection with HIV virus might be reduced in individuals who have good nutritional status, with micro-nutrient and, especially vitamin A playing a significant role (Friis, 1998). As the HIV virus damages the immune system, RYMV reduces chlorophyll in the rice plant with resultant reduction in photosynthesis, plant growth and development and subsequent death.

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This causes great nutrition and food security havoc to millions of people in SSA who depend on rice for calories.

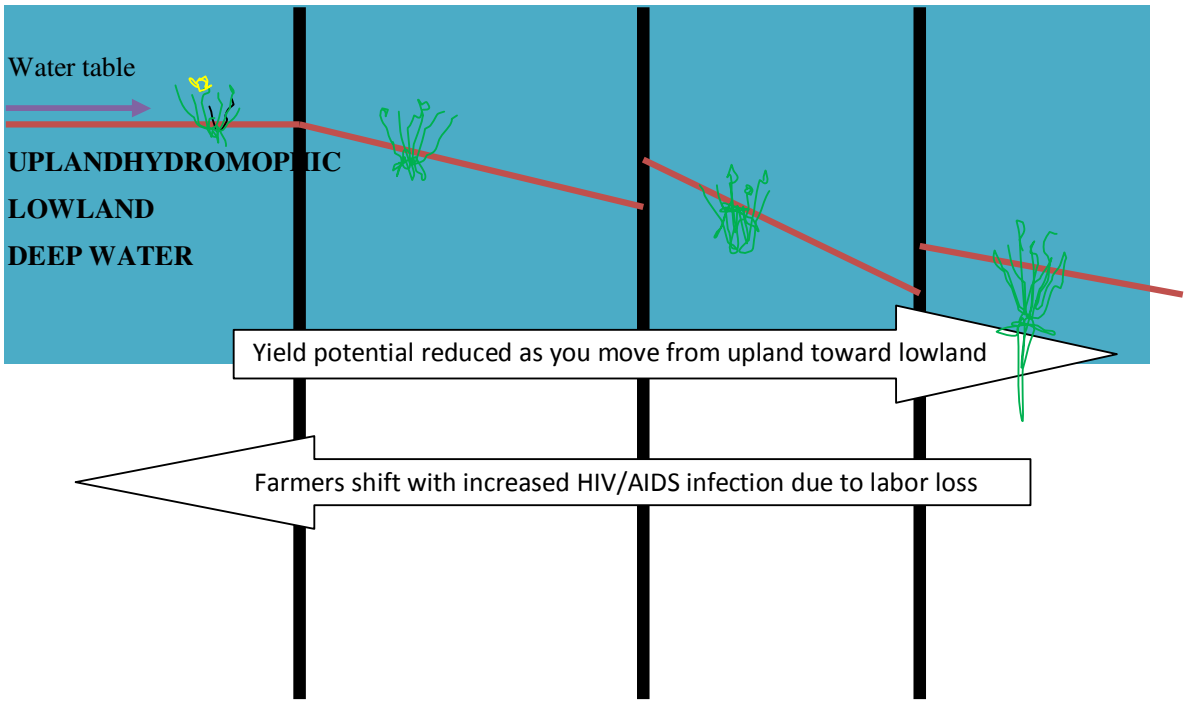

Fig.4. Hypothetical shift in production system with increasing HIV/AIDS pandemic

From socio-economic perspective, consequences of these two devastating pandemics for rice production and food security in SSA can be viewed from the point of reduced household source of calories, time loss to caring for the sick and total crop loss in severe RYMV attack. Households affected by HIV/AIDS and crop loss due to RYMV are at risk nutritionally, access to nutritious food is difficult; demand for care soars, productive time is lost, family income is depleted and become increasingly difficult to preserve health and rice production skills. The scenario presented is complex web, especially in rice production and its consequence on food security and nutrition.

Management Strategies to Mitigate HIV/AIDS and RYMV infections

At present there is no complete cure for HIV/AIDS. However, anti-retroviral drugs are available for the management of the disease. Maintenance of adequate nutrition by people living with AIDS has been advocated as one of the cheapest, safest and more sustainable management practice (Babamento & Kotler, 1997; Beach *et al.,* 1992; Macallan, 1999; Semba & Tang, 1999; Bogden *et al.,* 2000; Egounlety, 2006; Abo, 2006) and the efficiency of most drugs are known to enhance by better nutrition. The participatory nutrition approach being promoted by FAO's Food and Nutrition Division include the joint development of local household food and nutrition strategies based on local raw materials available in a given locally and food habit (Casleman, *et al.,* 2004).

In HIV/AID and RYMV affected communities, organizing local planning and training workshops to discuss local food security challenges posed by the devastating effects of both HIV/AIDS and RYMV among various local groups and institutions, Casleman, *et al*., (2004); Ekop (2006) suggested will help identify possible area of intervention and practical management techniques that could mitigate the negative impact of the pandemic. Lack of clear moral standard evidently promotes the spread of HIV and other sexually transmitted diseases (STD), and the presence of an STD increases the risk of HIV-1 infection by 2 to 5 folds (Awake, 2002). Poverty, ignorance and cultural practices where women have no right to question their partners about extra marital affairs are some of the ways HIV is spread fast in SSA. Therefore, investing public fund into poverty eradiation programs, public enlightenment and education on safe sex and medical practices and open discussion among partners and youths about sex life will go a long way in mitigating the spread of HIV. Leaning to live positively with the virus is

akey development tool for preventing 'treatment preparedness' in HIV/AIDS affected communities (Page *et al.,* 2007).

Control of RYMV is difficult because the virus is highly infectiousand because the epidemiology and role of vectorsare not wellunderstood. Natural resistance to RYMV exists in African land racesof rice. However, it has not been possible to achieve introgression ofthis resistance into cultivated rice because of fertility barriers andbecause resistance is a recessive, polygenic trait (Yvonne *et al.,* 1999), in 1995 several donor sponsored a regional workshop on the RYMV diseases to review the state of the art and determine research and management strategies that will be required to mitigate the effects of the virus (WARDA, 2000). Some of the research reports that follows indicates that appropriate spacing to avoid leaf contact of affected and unaffected plants, proper cleaning of contaminated hands, farm implements, and other sources of mechanical sap inoculation seems to be strategic in the management of RYMV (Abo, 2004). Destruction of rice stubbles after harvest, controlling insects vectors with insecticides, synchronous planting and safe cultural practice and avoidance of mono cropping of a susceptible rice varieties on a large scale are some of the safe management practices.

CONCLUSION AND RECOMMENDATIONS

The combined effects of these pandemics on nutrition and rice production is clearly related to people's livelihood and varies according to the different rice production ecologies, farming system, stage of the epidemic, level of poverty and general level of awareness. It may also result in shift from rice production to less labor intensive food crops, reduction in productivity and household cash income with correspondent adverse effect on nutrition, rice production and household food security. It can also be concluded that the best entry point for the mitigation of HIV/AIDS and RYMV on nutrition and sustainable rice production is through improving household food security, poverty eradication, enlightenment, and knowledge of the complex interactions among HIV/AIDS, RYMV, nutrition, food security, malnutrition including household coping strategies to offset labor shortage, decline in family income, poor nutrition will help in mitigating the impacts of the epidemic.

It is therefore important that policy makers and developmental project implementers attack the pandemic through a broad line approach by reducing drudgery associated with rice production through mechanization and social orientation at both community and household levels. The Economic Community of West African States (ECOWAS) should also harmonize HIV/AIDS with RYMV control strategies if the MDG goals are to be realized among the SSA states.

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