Institution: University of Leeds

Unit of Assessment: UoA06

Title of case study: Reducing the health burden of aflatoxins through policy and capacity building in sub-Saharan Africa

Period when the underpinning research was undertaken: 2002 - 2013

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Prof Yun Yun Gong	Research Fellow	2002 – 2013
	Professor in Food Safety and Global Health	2016 – present

Period when the claimed impact occurred: 2011 – present

Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact (indicative maximum 100 words)

Mycotoxins are poisonous compounds naturally produced by strains of fungus growing on staple cereals, nuts and oilseeds. Dietary exposure to aflatoxins, the most toxic mycotoxins, significantly increases the risk of chronic malnutrition and stunting in children. Prof Gong's research on the effects of mycotoxins on foetal development and children's health, alongside the evaluation of low-cost solutions to minimise dietary exposure, have influenced global food safety standards and policies. Additionally, in sub-Saharan Africa this research has built capacity, leading to increased preparedness to deal with outbreaks and financial support for aflatoxin control measures.

2. Underpinning research (indicative maximum 500 words)

Prof Gong has led an intensive research programme on different mycotoxins across Africa in collaboration with global partners such as the International Institute of Tropical Agriculture. This work has focused on providing several stages of evidence identifying the relationships between aflatoxin exposure and children's health. The primary method of measuring chronic malnutrition in children is the prevalence of stunting, affecting more than a third of children in African countries.

The first stage of the research examined the relationship between weaning practices, the levels of an aflatoxin biomarker, and growth parameters in 480 children aged 9 months to 5 years in Benin and Togo. This research reported a statistically significant association between biomarkers, the presence of aflatoxin in food, and three growth parameters. The findings strongly suggested that aflatoxin exposure contributes to the risk of chronic undernutrition and stunting **[1].**

The second stage of the research was a longitudinal study in Benin, examining aflatoxin exposure in children aged 16-36 months over an 8-month period. After adjustment for confounders, the children with lower levels of aflatoxin exposure had on average gained 1.7 cm more in height than those with higher exposure, thereby supporting the hypothesis that reducing aflatoxin exposure substantially reduces the risk of stunting **[2]**.

The third stage of research was a randomised controlled trial that evaluated the effectiveness of an intervention to reduce aflatoxin exposure. Prof Gong designed, implemented and evaluated low-cost, culturally acceptable intervention strategies to reduce post-harvest aflatoxin contamination and human exposure at the subsistence farm level in Guinea **[3]**. The intervention

package included education and facilities for effective post-harvest handling of maize. This intervention reduced aflatoxin exposure by 60% as assessed using an aflatoxin biomarker **[3]**.

Following this research, Prof Gong worked in the Gambia to assess how aflatoxin exposure in the womb limits the growth of infants in the first year of life. Biomarker levels were measured in maternal blood during pregnancy, in cord blood and infants at age 16 weeks. Levels in maternal blood were found to be a strong predictor of both weight and height gain in infants. A reduction in exposure from 110 pg/mg to 10 pg/mg was associated with a 0.8 kg increase in weight and a 2 cm increase in height within the first year of life. The research demonstrated that aflatoxins cross the maternal placental barrier **[4]**.

The extent of children's dietary exposure to two mycotoxins (aflatoxin and fumonisin B1) was demonstrated through a survey of 148 children aged 12–22 months in Tanzania. Working with the Tanzanian Food and Drug Authority (TFDA), aflatoxin and fumonisin biomarkers were were detected in 84% and 96% of children. The highest levels were measured in children who had been fully weaned. The research provided the first detailed quantitative exposure data on aflatoxin and fumonisin in Tanzanian children and demonstrated that consumption of contaminated maize-based food leads to chronic exposure to mycotoxins, increasing with age **[5]**.

3. References to the research (indicative maximum of six references)

[1] Gong, Y.Y., Cardwell, K., Hounsa, A., Egal, S., Turner, P.C., Hall, A.J., Wild, C.P. (2002). Dietary aflatoxin exposure and impaired growth in young children from Benin and Togo: cross sectional study. *British Medical Journal,* 325, 20-21. Doi: https://doi.org/10.1136/bmj.325.7354.20

[2] Gong, Y.Y., Hounsa, A., Egal, S., Turner, P.C., Sutcliffe, A.E., Cardwell, K., Wild, C.P. (2004). Post-weaning Exposure to Aflatoxin Results in Impaired Child Growth: a Longitudinal Study in Benin, West Africa. *Environmental Health Perspectives*, 112(13) :1334-1338. Doi: https://doi.org/10.1289/ehp.6954

[3] Turner, P.C., Sylla, A., **Gong, Y.Y.**, Diallo, M.S., Sutcliffe, A., E., Hall, A.J., Wild, C.P. (2005). Reduction in exposure to carcinogenic aflatoxins by post-harvest intervention measures in west Africa: a community-based intervention study. *The Lancet,* 365: 1950 – 1956. Doi: https://doi.org/10.1016/S0140-6736(05)66661-5

[4] Turner, P.C., Collinson, A, C., Cheung, Y, B., **Gong, Y.Y.**, Hall, A, J., Prentice, A.M., Wild, C.P. (2007). Aflatoxin exposure *in utero* causes growth faltering in Gambian infants. *International Journal of Epidemiology*, 36 (1119-1125). Doi: https://doi.org/10.1093/ije/dym122

[5] Shirima, C.P., Kimanya, M.E., Kinabo, J.L., Routledge, M.N., Srey, C., Wild, C.P., **Gong, Y.Y.** (2013). Dietary exposure to aflatoxin and fumonisin among Tanzanian children as determined using biomarkers of exposure. *Molecular Nutrition & Food Research*, 57 (1874-1881). Doi: https://doi.org/10.1002/mnfr.201300116

4. Details of the impact (indicative maximum 750 words)

Prof Gong's research on the effects of mycotoxins on foetal development and children's health, alongside design and evaluation of low-cost solutions to minimise dietary exposure, have influenced global food safety standards and policies. Additionally, in sub-Saharan Africa this research has built capacity, leading to increased preparedness to deal with outbreaks and financial support for aflatoxin control measures.

Influencing Global Food Safety Standards

Prof Gong's research has contributed evidence to world leading policy-making bodies and resulted in the creation and maintenance of crucial safety standards for contaminants. As a world-leading

expert in aflatoxins and their impact on chronic childhood malnutrition, Prof Gong is a working group member of the International Agency for Research on Cancer (IARC), whose reports influence global policy. Prof Gong's research is cited in IARC Report No. 9 **[A]**. This included evidence on how aflatoxins negatively affect children's growth and their impact upon foetus development in utero. The report also highlighted the urgent need for clear intervention measures and global action to prevent harm to children.

Prof Gong's research **[1-4]** strongly influenced a monograph **[B]** by the Food and Agriculture Organization and World Health Organization (WHO), two leading organisations involved in global food safety. The monograph was used to advise all member states on the safe evaluation of aflatoxin contaminants in food. A further WHO technical report **[C]** cites Prof Gong's work **[1,2,4]**, highlighting the need for intervention strategies.

Prof Gong has contributed extensively to the European Food Safety Authority (EFSA) as a working group member, authoring six official mycotoxins risk assessment documents over seven years. The decision to maintain the EU food safety regulation limit levels for *fusarium* mycotoxins has been based on this work **[D]**.

Influencing African Policy and Action

Prof Gong is an expert member of the Partnership for Aflatoxin Control in Africa (PACA) **[E]**, uniting more than 50 organisations from 54 African countries. Led by the African Union, PACA strategy aims to reduce aflatoxin exposure through awareness, preparedness and influencing government policy.

In 2013, PACA published a 10-year strategy document on aflatoxin control and evidence for action **[E]**. As an expert member, Prof Gong's research played a pivotal role in shaping this strategy. Prof Gong's research on the effects of aflatoxin on child stunting was cited in both the executive summary **[1,2]** and in the 'Opportunities to improve health' section **[1-3]** as evidence underpinning the need to reduce aflatoxin exposure.

Aflatoxin control actions have been established in 34 African states. PACA has led aflatoxin initiatives in three regional economic communities and 12 African countries, building awareness and improving preparedness amongst decision makers. Over 100 heads of state and government and ministers and deputy ministers have received training from PACA **[F]**.

In 2014, Prof Gong produced a series of technical reports as lead author to influence aflatoxin policy across the East African Communities (EAC) region **[G]**, based on research evidence **[1,2,4,5]**. In 2018, the EAC released nine policy briefings to their six-country membership as a direct result of these technical reports **[H]**. In addition, the EAC aflatoxin prevention, control strategy and action plan were underpinned by Prof Gong's research **[I]**.

The manager in charge of Food Risk Analysis at TFDA who worked with Prof Gong as a food safety scientist, credits Prof Gong's research for successfully dealing with an aflatoxin outbreak explaining that "capacity built through the implementation of Prof Gong's research facilitated successful investigation of a food borne disease outbreak, which occurred in Tanzania in 2016 as a result of consumption of maize contaminated with aflatoxin. The built capacity also facilitated the identification and implementation of appropriate risk management actions for control and prevention of the problem" **[I]**.

Research findings were input into the development of proposals for TANIPAC **[2,5 referred to in K]**. TANIPAC (Tanzania Initiative for Preventing Aflatoxin Contamination) is a $20M investment from the World Bank, Global Agriculture and Food Security Program and African Development Fund, developing a five-year project in Tanzania (2018-2023) aimed at minimising aflatoxin occurrence. Through developing infrastructure, including establishing post-harvest centres for grain and bio-control units, and raising public awareness through education, TANIPAC is expected

to benefit 60,000 farmers **[J]**. Five other African countries have also made financial commitments to create scalable models for aflatoxin mitigation **[F]**.

5. Sources to corroborate the impact (indicative maximum of 10 references)

[A] Mycotoxin control in low and middle-income countries (IARC Working Group Reports 2015) http://publications.iarc.fr/Book-And-Report-Series/Iarc-Working-Group-Reports/Mycotoxin-Control-In-Low--And-Middle-income-Countries-2015

[B] Safety evaluation of certain contaminants in food FAO JECFA Monographs (2016) http://www.inchem.org/documents/jecfa/jecmono/v74je01.pdf

[C] Evaluation of certain contaminants in food (2017) https://apps.who.int/iris/bitstream/handle/10665/254893/9789241210027-eng.pdf?sequence=1

[D] EFSA Contamination Panel Papers (2011 – 2018)

EFSA Panel on Contaminants in the Food Chain (CONTAM)* (2011). Scientific Opinion on the risks for animal and public health related to the presence of T-2 and HT-2 toxin in food and feed. EFSA Journal. Doi: https://doi.org/10.2903/j.efsa.2011.2481

EFSA Panel on Contaminants in the Food Chain (CONTAM)* (2013). Scientific Opinion on risks for animal and public health related to the presence of nivalenol in food and feed. EFSA Journal. Doi: https://doi.org/10.2903/j.efsa.2013.3262

EFSA Panel on Contaminants in the Food Chain (CONTAM)* (2014). Scientific Opinion on the risks to human and animal health related to the presence of beauvericin and enniatins in food and feed. EFSA Journal. Doi: https://doi.org/10.2903/j.efsa.2014.3802

EFSA Panel on Contaminants in the Food Chain (CONTAM)* (2017). Risks to human and animal health related to the presence of deoxynivalenol and its acetylated and modified forms in food and feed. EFSA Journal. Doi: https://doi.org/10.2903/j.efsa.2017.4718

EFSA Panel on Contaminants in the Food Chain (CONTAM)* (2018). Risks to human and animal health related to the presence of moniliformin in food and feed. EFSA Journal. Doi: https://doi.org/10.2903/j.efsa.2018.5082

EFSA Panel on Contaminants in the Food Chain (CONTAM)* (2018). Risk to human and animal health related to the presence of 4,15-diacetoxyscirpenol in food and feed. EFSA Journal. Doi: https://doi.org/10.2903/j.efsa.2018.5367

[E] PACA strategy (2013 – 2022) https://www.aflatoxinpartnership.org/sites/default/files/2018-05/PACA%20Strategy%202013-2022-%20FINAL%20formatted%20for%20A4_0.pdf

[F] PACA 1 Results and Impacts Infographic (2017) https://www.aflatoxinpartnership.org/sites/default/files/2019-04/PACA%20Phase%20I%20Results%20and%20Impacts%20-%20Infographic_Jan%202017.pdf

[G] Development of aflatoxin policy recommendations for aflatoxin control in the EAC region (2015) https://aflasafe.com/wp-content/uploads/pdf/TPP-2-Aflatoxin-and-the-1,000-Days.pdf, https://aflasafe.com/wp-content/uploads/pdf/TPP-8-Aflatoxin-Standards-for-Food.pdf

[H] EAC Policy Briefs on Aflatoxin Prevention and Control (2018) https://www.eac.int/documents/category/aflatoxin-prevention-and-control

[I] Letter of recommendation from the manager in charge of Food Risk Analysis at the Tanzania Food and Drugs Authority (TFDA), 24/09/20 (2020)

[J] TANIPAC Project information (2019)
https://www.gafspfund.org/projects/tanzania-initiative-preventing-aflatoxin-contamination-tanipac

[K] TANIPAC Successful Proposal for investment (2017)
https://www.gafspfund.org/sites/default/files/inline-files/5a.%20Tanzania_GAFSP%20Proposal.pdf