

# Linkages between Agricultural Diversification, Dietary Diversity, and Nutrition Outcomes in Sub-Saharan Africa: A Systematic Review

Sidney Lulanga<sup>1</sup>, Pamela A. Marinda<sup>2\*</sup>, Christopher Khayeka-Wandabwa<sup>3\*</sup>

<sup>1</sup>School of Humanities and Social Sciences, University of Zambia, Lusaka, Zambia

<sup>2</sup>Department of Food Science and Nutrition, School of Agricultural Sciences, University of Zambia, Lusaka, Zambia

<sup>3</sup>School of Pharmaceutical Science and Technology (SPST), Health Science Platform, Tianjin University, Tianjin, China

Email: \*ayiera@yahoo.co.uk, \*khayekachris@yahoo.com

**How to cite this paper:** Lulanga, S., Marinda, P.A. and Khayeka-Wandabwa, C. (2022) Linkages between Agricultural Diversification, Dietary Diversity, and Nutrition Outcomes in Sub-Saharan Africa: A Systematic Review. *Agricultural Sciences*, 13, 879-896.

<https://doi.org/10.4236/as.2022.137055>

**Received:** April 22, 2022

**Accepted:** July 24, 2022

**Published:** July 27, 2022

Copyright © 2022 by author(s) and Scientific Research Publishing Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

## Abstract

An enabling policy environment and good governance are fundamental drivers for agriculture and food systems, framing how they work and for whom in the global efforts to achieve Sustainable Development Goal 2 and food justice for all. The review examined the policy environment in sub-Saharan Africa in relation to linkages between agricultural diversification, dietary diversity, and nutrition. The systematic review of literature entailed searching Ovid MEDLINE, PubMed, Embase, African Journals Online and PsychINFO databases from Jan 1, 2010, to Feb 30, 2021, for eligible studies and technical reports. Publications reporting on agricultural diversification, dietary diversity, and nutrition outcomes in relation to policy environment were included. Qualitative synthesis of the abstracted evidence was conducted. SSA countries recognise the crucial role of agricultural diversification as a pathway to achieving food security with increasing emphasis on smallholder farmers. There is a rich base of policies that are complemented by lived experiences and best practices which can strengthen linkages between agricultural diversification, agribusiness and dietary diversity. For instance, the application of precision farming, agro-ecological zones targeted agricultural intensification and gender sensitive land administration, access and tenure in countries experiencing declining farm size could potentially ensure the youth, men and women have equitable and innovative opportunities of access to elements of improved agricultural systems. Smallholder farmers with the majority in rural settings, maintain *de facto* agricultural diversity. It is essential for any policy design or intervention to take into account the specific country's context; pay particular attention to socioeconomic capabilities of the rural population along with fiscal capacity and trade-offs. Empirical evidence on the

nexus between agricultural diversification and nutrition is mixed and limited.

## Keywords

Agricultural Diversification, Dietary Diversity, Sub-Saharan Africa, Policy, Nutrition

---

## 1. Introduction

Since the 1980s, a better understanding of the prospective pathways linking agriculture and nutrition has led to a noteworthy increase in research on the design, feasibility and impact of nutrition-sensitive agricultural interventions. These interventions have aimed at improving the underlying determinants of nutrition outcomes through targeting dietary diversity and quality, household food security, small-farm production and income empowerment [1] [2]. In September 2015, the United Nations general assembly adopted the 2030 agenda for Sustainable Development which entails 17 Sustainable Development Goals (SDGs). The second SDG, on zero hunger, focuses on ending hunger, achieving food security and improving nutrition and promoting sustainable agriculture [3]. In line with SDGs 1 and 2, when appropriately interlinked, agricultural diversification and dietary diversity constitute a common galvanizing approach to attaining food and nutrition security [3] [4].

It is estimated that ~795 million people suffer from undernutrition globally [5] with ~780 million of these living in developing nations [6]. Moreover, about 2 billion people suffer from low intakes of vitamins and minerals such as iron and zinc [7]; these nutritional deficiencies are a result of low food quantities consumed and/or poor dietary quality. Thus, it is envisioned that diversified agricultural production is likely to provide a wide range of different types of foods to the most vulnerable population segments [8] [9]. In SSA, by 2018 about 237 million people were undernourished [10]. Organizations including the World Health Organization (WHO), the Food and Agriculture Organization (FAO) of the United Nations, the Consultative Group on International Agricultural Research (CGIAR) and HarvestPlus have advocated for dietary diversity strategies to tackle the burden of micronutrient malnutrition [11] [12] [13]. This is driven by empirical evidence which suggests that dietary diversity is a proxy of diet quality and the consumption of a variety of foods across and within food groups and across different varieties of specific foods is a precondition for adequate intake of essential nutrients [14] [15] [16] [17] [18].

While undernutrition and low dietary diversity remain big problems in many developing countries [5] [6]; a large proportion of the people affected are small-holder farmers. Therefore, it is often presumed that further diversifying small-farm production would be a good strategy to improve nutrition, but the evidence is mixed. Moreover, the interplay between an enabling policy environment and

research evidence on the potential impact of interventions in agriculture on nutrition outcomes is of particular relevance in sub-Saharan Africa context where agriculture-related activities are a major source of livelihoods for majority of the population, and where malnutrition afflicts a high proportion of the population. To this end, the review seeks to evaluate the linkages between agricultural diversification, dietary diversity, and nutrition outcomes with a focus on; examining how different agricultural diversification policies and dietary diversity affect or impact on nutrition outcomes and identify factors that influence the magnitude of this relationship. Second, the insights aim to demonstrate the critical role of policy in guiding the structural transformation in agriculture to help realize multiple goals, including the affordability and availability of diverse food supply, safe and high quality diets, and rural income growth, especially for vulnerable groups like women and children. Thirdly, we present policy implications for addressing challenges associated with malnutrition in SSA.

## 2. Methods

### 2.1. Search Strategy

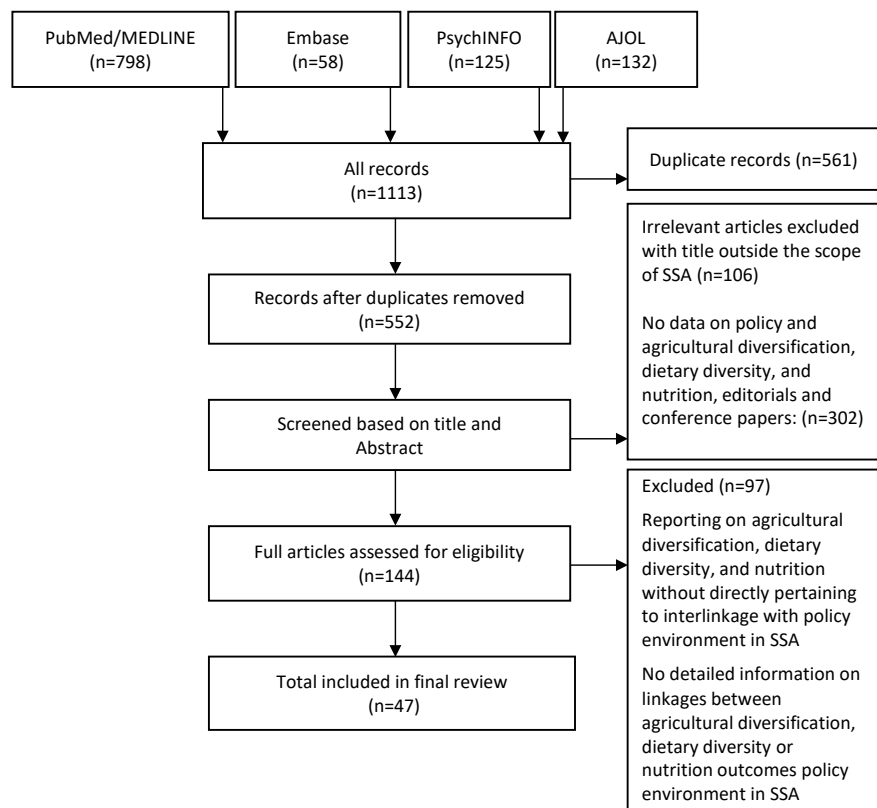
An extensive search of numerous sources was conducted to ensure an unbiased sample of both published and grey literature for the period Jan 1, 2010, to Feb 30, 2021. The timeline was purposely chosen as it represents an overlap between the last five years phase of Millennium Development Goals (MDGS) implementation and the first phase of Sustainable Development Goals (SDGS) which provides a desirable comprehensive transition interphase in terms of policies and strategic plans appraisal, re-formulation or formulation while addressing unfinished agenda with the shift to SDGs [3] [4]. The method used adopted guidelines on preferred reporting for systematic reviews [19] and the Cochrane principles [20] where applicable. We searched Ovid MEDLINE/PubMed, Embase, African Journals OnLine (AJOL) and PsychINFO databases for relevant articles. Database and repository searches were conducted in English language. An asterisk (\*) was used to pick up multiple word endings for instance Afric\* to pick up Africa and African and the following keywords/phrases were identified and used in various combinations with boolean operators (and, or): “sub-Saharan Afric\*” or Afric\* or “Afric\* countries” and agricultural diversification or agriculture diversity and policy\*; dietary diversity or dietary assessment or nutrition diversity or nutrition assessment and policy\*; diet\* and assess\* and policy\*; nutrition\* and assess\* and policy\*. With regard to AJOL, the search string was modified due to differences in database functionality to “sub-Saharan Africa” and “agricultural diversification policy” or “dietary diversity policy” or “nutrition diversity policy”. Building on the experience of prior research on systematic review of grey literature and its significance [21], additional technical reports with a focus on sub-Saharan Africa were retrieved from relevant institutional websites (like the Africa Union, Agriculture for food security 2030 (AgriFoSe2030) and Food

and Agriculture Organization of the United Nations (FAO) in January 2021. The search outputs were exported to endnote for review of titles and abstracts. A total of 1113 relevant research articles outputs (**Figure 1**) were collected in the initial search.

## 2.2. Selection of Articles

The inclusion criteria were applied by the reviewers to all studies at title and abstract level. Whenever it was not clear whether a study met the criteria, the reviewers consulted further. Relevant studies included all studies that have reported on policy and agricultural diversification, dietary diversity or nutrition outcomes in sub-Saharan Africa context. Besides, for each study to be included, it had to pass the following specific criteria: 1) relevant policy direction in relation to agricultural diversification, dietary diversity, and impact and/effect on nutrition; 2) relevant subject: precision agriculture used in the general areas of agriculture and/or diversification, nutrition and/or diversification, agriculture and/or economic outcomes.

The exclusion criteria were applied at both title and abstract level. The studies were excluded at the title level if the title was outside the geographic scope of SSA or the title was not within the general topics of agricultural diversification,



**Figure 1.** Flow diagram of the study selection. The summary search strategy databases, inclusion and exclusion criteria with a final eligibility of 47 studies incorporated in the study analysis.

dietary diversity, and nutrition. At the abstract level, studies were excluded if the abstract was not in English, abstract not available, abstracts outside the general topics of agricultural diversification, dietary diversity, and nutrition, abstracts that mention agricultural diversification, dietary diversity, and nutrition concepts without any policy component on their findings and application in SSA. The applied selection criterion is summarized in **Figure 1**.

### **2.3. Analysis and Synthesis**

A qualitative synthesis of the information was conducted, and information obtained categorized in three main themes. First, identified agricultural diversification policies in relation to dietary and nutrition diversity was reviewed, synthesized and described. Next, policy outlook in guiding structural transformations in agriculture is presented. Finally, an exploration of policy implications for addressing challenges associated with malnutrition in SSA was done. The findings are presented using narrative summaries.

## **3. Results and Discussion**

### **3.1. Agricultural Diversification Policies in Relation to Dietary and Nutrition Diversity**

It is evident, agricultural development policies, implementation strategies, guidelines and action plans are cognizant of the fact that, there is no one-size-fits-all solution for fostering agricultural diversification in SSA as an entry point for stimulating agricultural modernization and enhanced productivity particularly for the smallholder farmers who are the majority. At regional and national level, the various policy documents and related monitoring and/or implementation research evidence address different but thematically inter-related dimensions of agricultural diversification vis-a-vis dietary and nutrition diversity [4] [10] [22] [23] [24] [25] [26]. The interlinked dimensions of focus as observed in our review entail: 1) governments commitment in supporting subsidies and enhancing public expenditure in agriculture diversity, 2) more efforts directed towards creating an enabling environment for competitive market locally and globally, 3) increased investment in agricultural research and development, 4) the need to strengthen nutritional awareness advocacy, 5) better land administration in terms of land and water tenure policies and laws to ensure equitable access and tenure security, and 6) more resilient agroecosystem through on-farm diversification aimed at invigorating climate shocks adaptation resilience, better dietary diversity at household level and agribusiness incentives [4] [10] [22] [23] [25]-[31].

Smallholder farmers across the region maintain *de facto* agricultural diversity with a strong association between small scale production diversity and self-consumption for food and to a large extend cash income [4] [10] [22] [27] [28] [30]. Subsequently, policy decisions to improve food security in SSA have significantly enhanced a positive interplay between agriculture diversity and household dietary

consumption behaviors thus positively influencing household nutrition outcomes and agriculture related climate change resilience due to alternative paths for food and income security [4] [10] [24] [27]. On the other hand, implementation assessment of the policies, strategies, guidelines and action plans across different nations in SSA reveal that, mechanism by governments in supporting subsidies, ensuring access to agricultural technologies, agricultural advisory services, training, timely and relevant information as well as trickledown effect of public expenditure targeting smallholder cadre of farmers who are majorly in remote rural settings remain poorly streamlined for farmers access and benefit [8] [10] [25] [30] [31]. Even though implementation of some of the policies and guidelines has uplifted agribusiness, they have equally fallen short of actualizing enabling environment for market access. The persistent and much needed enabling agricultural diversification stimulus environment across the region is in two domains. First, the need of an enabling physical investments and support that entail rural-rural and rural-urban transport connections in terms of road networks, communication services like mobile and internet network, climate change prediction information flow, quality of farm inputs and favourable costs and guaranteed human and agribusiness investments security. Secondly, provision of agricultural extension advisory services, training and timely and relevant information, tailored to different types of farmers across regions within a nation in order to sustain existing and emerging interest of investment in agricultural diversification at large.

### **Household Dietary Diversity and Production Diversification Effects on Nutritional Outcome**

The existing empirical evidence with regards to establishing the direct causal link between agriculture diversification and nutrition is mixed. For instance, in Kenya, small livestock assets such as poultry, cattle ownership and milk consumption as well as pulses farming among the ultra-poor labour-constrained farmers were positively correlated to household nutrition [32]. Besides, in Ghana, agriculture production diversity has been demonstrated to be important for household dietary diversity and nutrition with much attention linked to its value for an income effect [33]. Among rural small holder farmers in Zambia, while agricultural diversification was associated with the household dietary diversity score, the relationship was not significant and that behavioural change communication should be factored as a critical component of agricultural diversity advancement programs [34]. The behavioural change advanced, resonates with the fact that, food seeking behaviours influence individual food consumptions patterns and dietary diversity, hence the need for a better understanding of the link between dietary diversity, nutrition security and the associated factors [35] [36]. In Mali, findings on impact of crop diversification on household nutrition, socioeconomic influences were proven to have a positive influence on food consumption and household nutritional security [37]. Thus, to improve crop diver-

sification and the nutritional quality, there is need to invigorate diversification through subsidies among other measures that can then translate to impactful nutritional status [37]. The mixed outcomes outlined by the case examples demonstrate that agricultural diversification alone is not adequate to contribute to a positive change in nutrition outcomes, and mirrors the inherent needs, challenges and opportunities as concerns African Agriculture and its effect on food security resilience and nutrition [23] [38].

### 3.2. Policy Outlook in Guiding Structural Transformations in Agriculture

Globally, agricultural production transformation has been shaped by forces of globalization while related policies and programs are established in particular political, social and economic contexts with a broader aim to bring nutritious diets within reach of the poor [39] [40]. Therefore, examining policy and programmes interplays that shape agriculture production can contribute to better understanding of policy implementation, uptake and impact by identifying policy levers, obstacles and windows of opportunity [39] [40]. Across the SSA nations, there is a great variety of agroecological zones and large differences in land, labour and other resources but there is a wide overlap in the national and regional agricultural policies in place [41] [42] [43].

Overlaps observed largely driven by regional agricultural policies as envisioned by regional economic communities (RECs) which have overlapping memberships [42] [44]. For instance, Agriculture for food security 2030 (Agri-FoSe2030), a think-tank programme that targets the UN Sustainable Development Goal 2 in low-income countries, in its focus on SSA, synthesizes and translates existing science into policy and practice, and develops capacity to achieve the goal [41] [45]. Yet, in its membership and thematic scope for example in theme 1 (social and economic dimensions of smallholder based agriculture and food security) in the focus countries for example, there is Tanzania being both a member of EAC and SADC while Kenya being a member of both EAC and COMESA, and Malawi and Zambia being a member of both COMESA and SADC among others [41] [42]. By virtue of these overlaps, harmonized implementation of various structural transformations such as those aimed at raising smallholder productivity, combating hunger and improving rural livelihoods through improving technology use to enhance women's participation and stimulate inclusive and efficient markets is hampered by factors like variable scale of technological advancement in the different countries [46] [47].

Even so, right through the respective national and regional economic communities policies, the aim of the various policy and implementation strategies in guiding the structural transformation in agriculture to help realize multiple goals (including affordability and availability of diverse food, ensuring high quality and safe food for the population, especially the vulnerable groups) is centered on agriculture commercialization and intensification [47] [48] [49]. In the same

framework, other than focusing on smallholder farmers, there is gradual integration of women and youth in order to actualize sustainable intensification geared towards enhancing food security. The SSA context of policy support in agricultural diversification, guiding structural transformations, dietary and nutrition diversity is summarized in **Table 1**. While empirical analyses have shown clear relations between farming diversity and food security, and a linkage to nutritional diversity in SSA, mixed findings have been reported on how market orientation influences the relationship [27] [33] [50]. Therefore, is need for a strong private public partnership multi-sectoral approach to focus on niche product markets, certification schemes, price and credit incentives to promote diversification, while intensifying production systems [23] [28] [33] [38] [50].

On the other hand, despite enormous potential in agriculture, many SSA nations are struggling to meet their food needs [51] [52] [53]. According to African development bank, 65% of the world's arable land is in Africa despite the continent being a net importer of food with \$35 billion expenditure on food imports annually. Over 80% of 874 million hectares of land that is considered suitable for agricultural production suffers from serious soil fertility challenges or other limitations to achieving high and sustained productivity [54] [55] [56] [57]. While climate change is predicted to significantly affect arable land health and agricultural output, the demand for food in Africa is expected to rise by over 60% by 2050 due to population growth and improvements in nutrition [54] [55] [56] [57]. Africa requires a significant improvement in agricultural productivity and resilience to achieve sustainable growth and development. Accelerating key elements highlighted in **Table 1** would guarantee improved agricultural systems in SSA countries in tune with the targets of SDG 1 and 2.

**Table 1.** Extent of policy support in structural transformation in agriculture for agricultural diversification, dietary and nutrition diversity in SSA.

Regional/Country and/or IREC priority umbrella	Policy framework and strategic plans initiative	Structural transformation in agriculture	Reference
-SSA under AgriFoSe2030 memberships. -Case studies of SSA advanced pilot reports for adaptation and replication across the region as seen from work in Nigeria, Kenya and South Africa.	-Precision agriculture (PA) or precision farming. -Mobile technology and other smart technologies deployment to drive all processes, from tilling to post-harvesting.	-To adapt cultivation and animal husbandry practices to local or even within-field conditions rather than to use general recommendations. -Target increased productivity among smallholder farmers in Sub-Saharan Africa through attaining appropriate management strategies in terms of efficiency and effectiveness of resource use. -Application of mobile technology devices to create opportunities for agribusiness, banking, commerce and investment. -Invigorate sustainable agricultural intensification among smallholder-based farmers.	[40] [41] [45] [47] [48] [51] [54]



**Continued**

<p>-Action plans related to national vision documents across SSA countries (e.g., South Africa Vision 2030, Nigeria Vision 2030, Kenya Vision 2030, Rwanda Vision 2020, Senegal Vision 2035, Cameroon vision 2035 etc).</p>	<p>-Food Security and economic policies.          -Agricultural diversification, dietary and nutrition diversity.          -Eco-conscious agricultural production.          -Youth and women empowerment and entrepreneurship with a focus on agribusiness.          -Gender sensitive land administration, access and tenure in countries experiencing declining farm size.          -Agro-ecological zones targeted agricultural diversification and intensification.</p>	<p>-Increase government support to timely access of improved and good quality agro-inputs like seeds promote sustainable use of fertilizers and development of sustainable irrigation systems.          -Accelerate key elements of improved agricultural systems; improving food trade and market integration through enhanced transport systems infrastructure and information systems at rural-urban, rural-rural and intra-Africa as well as internationally that allow for a better functioning of markets for both staples and non-staples especially for perishable products such as fruits, vegetables and livestock products, etc.          -Private and state trade support and public buffer stocks.          -Improve farmers' skills and technical expertise in modern food production systems especially in rural settings and promote diversification into multiple enterprises, such as fisheries, livestock, apiculture, snail and mushroom production etc.          -Adopting and advancing modern research approaches to adapting existing crops to the changing climate in order to meet food needs.          -Harnessing biotechnological tools proactively to enhance long-term improvement in breeding, developing and promoting adaptive cultivars, encourage climate resilience in the gene pool, and catalyse a move away from over-dependence on land and exposed cultivation systems.          -Enhancing legal infrastructure, awareness, administrative and technical capacity in implementing statutory laws related to land tenure and ownership while remaining alive of cultural, communal and religious barriers that can facilitate or limit optimal land use for agriculture production without gender bias.</p>	<p>[4] [22]          [23] [24]          [27] [28]          [29] [31]          [33] [38]          [40] [41]          [43] [47]          [48] [52]          [53] [54]          [58] [59]          [60] [61]</p>
<p>African Union Institutional capability.</p>	<p>-Comprehensive African Agricultural Development Programme (CAADP); Implementation of Agriculture, Rural Development, Blue Economy and sustainable environment policies, programs and strategies in line with the aspirations of Agenda 2063.</p>	<p>-African governments to allocate at least 10% of national budgets to agriculture and rural development, and to achieve agricultural growth rates of at least 6% per annum.          -Reducing poverty and malnutrition, for increasing productivity and farm incomes, and for improvements in the sustainability of agricultural production and use of natural resources.          -Enhance resilience to climate variability through development of disaster preparedness, early warning response systems and social safety nets.          -Trade and financial integration to incentivize manufacturing and agricultural sector value additions.</p>	<p>[41]          [61]-[67]</p>

### 3.3. Policy Implications for Addressing Challenges Associated with Malnutrition in SSA

Although climatic and/or biophysical, socio-economic, markets, institutional and policy factors greatly influence agricultural diversification decisions, it is often policies, both national and international, that have a decisive impact on agricultural diversification, dietary diversity and nutrition outcomes [68]. Thus, we further examine policy implications for addressing challenges associated with malnutrition in SSA in which we group policies into three (3) broad categories under policies and programmes for improving nutrition: 1) international initiatives - making nutrition a development priority; 2) national initiatives - policies and programmes; and 3) priorities and approaches for responding to threats to nutrition from climate change and biofuel demand.

The majority of international commitments support nutrition programs that reduce infant and maternal mortality, advance women and girls empowerment, and promote lifelong health development. In light of the shifting nutrition environment, the COVID-19 and other potential pandemic related challenges and impact, modern agricultural productivity, population shifts, and climate change, a larger, “multi-sectoral food systems approach” is required to establish robust food systems with beneficial nutrition and health outcomes [69]. Almost all countries have action plans related to agricultural diversification, dietary diversity and nutrition, as well as overall national vision documents (e.g., South Africa Vision 2030, Nigeria Vision 2030, Kenya Vision 2030, Rwanda Vision 2020, Senegal Vision 2035), national development plans, national green growth development strategies, all often based on international declarations or strategies [10]. Many have also put in place sectoral food security, agriculture and climate change policies and strategies that indicate their treatment of nutrition. Most countries recognise the value of agricultural diversification for dietary diversity and improved nutrition, yet some have declared the pursuit of agricultural specialisation and intensification as important for national economies, while some advertently or inadvertently promote specialisation under the pretext of improving national food security.

Evidence demonstrates that national agricultural systems in SSA as well as individual farmers and communities are not sufficiently diversified which undeniably leads to vulnerability to malnutrition [52] [70]. Low productive diversification, alongside frequent lack of assets to buffer against risks, exposes farmers to risks of income variability, crop failure, and consequently malnutrition. In some extreme cases, disturbances in production lead to severe malnutrition since poor farming households have low purchasing power to compensate for missing required nutrients especially for children and mothers. Unsurprisingly, poor undiversified farming households also struggle to ensure dietary diversity and nutrition as they have limited resources to supplement the consequential shortfall in dietary diversity and nutrition [10].

Since agricultural diversification, dietary diversity and nutrition features

prominently in food security, health and resilience strategies of SSA countries, there is greater need to improve awareness and strengthen agricultural extension with inclusion of nutrition messages. Knowledge and awareness on agricultural diversification are increasingly recognised as a key factor in achieving food security objectives in SSA countries. Though, nutrition outcomes are not always met, especially when the agriculture production is dominated by the production of few crops and/or in some cases one major crop. Maize, for example, accounts for almost half of the cultivated land in six countries: Lesotho (61 percent), Zimbabwe (51 percent), Zambia (49 percent), South Africa (49 percent), Botswana (43 percent), and Malawi (43 percent) [10].

It therefore follows that; policies need to take into account the diversity of conditions in which farmers in Sub-Saharan Africa farm by virtue of respective regional blocks and at national level, if they are to nudge them in the right direction on agricultural diversification. Governments should aim at creating an enabling environment for agriculture where diversification is complementary: as sometimes necessary to boost dietary diversity and nutrition, while other times needed as a step towards greater economic efficiency, higher-added value and ultimately structural transformation. Within this space, public policy should aim to find balance, mindful of important implications that agricultural diversification has for dietary diversity and nutrition, as well as acknowledge the fiscal constraints that might at times argue in favour of alternative interventions.

It is, therefore, important to note that farmers in SSA 's decision, for example, to diversify does not only rest on their understanding of the resulting impacts but is influenced by the specific context in which the consideration is made. They are mainly constrained by the realities of the environment around them, by the changing public policies and market infrastructure, and by factors specific to the organisation of society and economy in which they live and operate [10]. These specific conditions generate drivers of production decision and nudge the farmer either towards diversification. These drivers would be of particular importance to policy makers since they can be influenced or prepared for by policy decisions and the set-up of institutions. These drivers would be grouped into three broad categories:

1) Environmental drivers—that take cognisance of the climatic or biophysical factors & agro-ecological zones, climate, natural resources, the prevalence of pests/diseases and environmental shocks.

2) Policy and market drivers—that take cognisance of the measures put into place that promote national food security, productivity enhancement and commercialisation, as well as regulatory measures that condition market access.

3) Socio-economic and institutional drivers—that take cognisance of the rules & regulations, subsidies & incentives, practices, factor endowment, power distribution, education, gender and broad conditions within the community(ies).

In the appraisal of various policies, we actualize the fact that, in order to create better performing programmes, policy makers and think-tanks programmes that

synthesize and translate existing science into policy and practice, and develop capacity to achieve the goal can take the following lessons learned into account. First, the Agricultural Input Support Programmes (AISPs) need to be clearly and unequivocally aligned with national food security, resilience and nutrition objectives, while reconciling the arguably competing objectives of increasing productivity as well as increasing agricultural diversity. Second, procurement and distribution of subsidised inputs should facilitate the development of competitive private sector-led input markets. Third, parallel investments in the development of relevant infrastructure that promotes overall market-functioning improvements (e.g. roads, market centres, storage facilities, transport and processing equipment for a wide variety of agricultural products) particularly in rural areas will likely enhance the outcomes of AISPs. Finally, subsidies should be part of a holistic approach to enhancing the use of a wide variety of improved inputs and not only fertilizer through the provision of complementary services (e.g., research and extension, irrigation, credit), social policy measures (e.g., productive safety nets, cash transfers) and private sector-led market development (e.g., policy reforms, infrastructure development) [70] [71].

#### 4. Conclusion and Policy Message

It is apparent; most countries in Sub-Saharan Africa recognise the crucial role of agricultural diversification as a pathway to achieving food security and consequently meeting nutrition and dietary diversity needs of the people. There is a rich base of policies and related lived experiences which in combination can guide the scaling up of some best practices and incentivise the linkage between agricultural diversification, agribusiness, dietary diversity and nutrition outcomes. For instance, among other factors, the application of precision farming, agro-ecological zones targeted agricultural intensification and gender sensitive land administration, access and tenure in countries experiencing declining farm size would potentially ensure the youth, men and women have equitable and innovative opportunities of access to elements of improved agricultural systems. More considerations about the importance of dietary diversity and nutrition need to be built into policies beyond those directly treating agriculture productivity and its diversification. Such efforts should consider a greater focus on smallholder farmers across the regions within SSA who as a matter of fact, maintain *de facto* agricultural diversity. Empirical evidence on the nexus between agricultural diversification and nutrition is mixed and limited.

#### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

#### References

- [1] Ruel, M.T. and Alderman, H. (2013) Nutrition-Sensitive Interventions and Programmes: How Can They Help to Accelerate Progress in Improving Maternal and

- Child Nutrition? *The Lancet*, **382**, 536-551.  
[https://doi.org/10.1016/S0140-6736\(13\)60843-0](https://doi.org/10.1016/S0140-6736(13)60843-0)
- [2] Saaka, M., Osman, S.M. and Hoeschle-Zeledon, I. (2017) Relationship between Agricultural Biodiversity and Dietary Diversity of Children Aged 6-36 Months in Rural Areas of Northern Ghana. *Food & Nutrition Research*, **61**, 1391668.  
<https://doi.org/10.1080/16546628.2017.1391668>
- [3] Kumar, S., Kumar, N. and Vivekadhish, S. (2016) Millennium Development Goals (MDGS) to Sustainable Development Goals (SDGS): Addressing Unfinished Agenda and Strengthening Sustainable Development and Partnership. *Indian Journal of Community Medicine. Official Publication of Indian Association of Preventive & Social Medicine*, **41**, 1-4. <https://doi.org/10.4103/0970-0218.170955>
- [4] Gil, J.D.B., Reidsma, P., Giller, K., Todman, L., Whitmore, A. and van Ittersum, M. (2019) Sustainable Development Goal 2: Improved Targets and Indicators for Agriculture and Food Security. *Ambio*, **48**, 685-698.  
<https://doi.org/10.1007/s13280-018-1101-4>
- [5] IFAD, FAO and WFP (2015) The State of Food Insecurity in the World: Meeting the 2015 International Hunger Targets: Taking Stock of Uneven Progress. FAO, Rome.
- [6] WFP, FAO and IFAD (2015) The State of Food Insecurity in the World 2012, Economic Growth Is Necessary But Not Sufficient to Accelerate Reduction of Hunger and Malnutrition. Rome, FAO.
- [7] Fritschel, H., Carter, T., Whitehead, J. and Marble, A. (2014) Actions and Accountability to Accelerate the World's Progress on Nutrition. International Food Policy Research Institute, Washington DC.
- [8] Pingali, P. (2015) Agricultural Policy and Nutrition Outcomes—Getting beyond the Preoccupation with Staple Grains. *Food Security*, **7**, 583-591.  
<https://doi.org/10.1007/s12571-015-0461-x>
- [9] Abraham, M. and Pingali, P. (2017) Transforming Smallholder Agriculture to Achieve the SDGs. In: Paloma, S.G., Riesgo, L. and Louhichi, K., Eds., *The Role of Smallholder Farms in Food and Nutrition Security*, Springer, Berlin, 173.  
[https://doi.org/10.1007/978-3-030-42148-9\\_9](https://doi.org/10.1007/978-3-030-42148-9_9)
- [10] World Bank (2018) Productive Diversification of African Agriculture and Its Effects on Resilience and Nutrition.
- [11] Girma, W. and Genebo, T. (2002) Determinants of Nutritional Status of Women and Children in Ethiopia.
- [12] M. Nepal, New ERA and ICF International (2011) Nepal Demographic and Health Survey.
- [13] Page, A. (1999) The UN System's Forum for Nutrition Sub-Committee on Nutrition (ACC/SCN). In: Pojda, J. Ed., *Human Rights, Health and Nutrition*, UNSSCN, 32.  
<http://www.nzdl.org/cgi-bin/library.cgi?e=d-00000-00---off-0fml2%2E2--00-0---0-10-0---0---0direct-10---4-----0-11--11-en-50---20-about---00-0-1-00-0-11-1-OutfZz-8-00&cl=CL2.1&d=HASH0126e3a526d74d5ac6c8c876.2&gt=1>
- [14] Arimond, M. and Ruel, M.T. (2004) Dietary Diversity Is Associated with Child Nutritional Status: Evidence from 11 Demographic and Health Surveys. *The Journal of Nutrition*, **134**, 2579-2585. <https://doi.org/10.1093/jn/134.10.2579>
- [15] Frison, E.A., Smith, I.F., Johns, T., Cherfas, J. and Eyzaguirre, P.B. (2006) Agricultural Biodiversity, Nutrition, and Health: Making a Difference to Hunger and Nutrition in the Developing World. *Food and Nutrition Bulletin*, **27**, 167-179.

- <https://doi.org/10.1177/156482650602700208>
- [16] Kennedy, G.L., Pedro, M.R., Seghieri, C., Nantel, G. and Brouwer, I. (2007) Dietary Diversity Score Is a Useful Indicator of Micronutrient Intake in Non-Breast-Feeding Filipino Children. *The Journal of Nutrition*, **137**, 472-477. <https://doi.org/10.1093/jn/137.2.472>
- [17] Moursi, M.M., Arimond, M., Dewey, K.G., Treche, S., Ruel, M.T. and Delpuech, F. (2008) Dietary Diversity Is a Good Predictor of the Micronutrient Density of the Diet of 6- to 23-Month-Old Children in Madagascar. *The Journal of Nutrition*, **138**, 2448-2453. <https://doi.org/10.3945/jn.108.093971>
- [18] Kennedy, G., Ballard, T. and Dop, M. (2011) Guidelines for Measuring Individual and Household Dietary Diversity. Nutrition and Consumer Protection Division, FAO, Rome.
- [19] Liberati, A., Altman, D.G., Tetzlaff, J., Mulrow, C., Gøtzsche, P.C., Ioannidis, J.P., Clarke, M., Devereaux, P.J., Kleijnen, J. and Moher, D. (2009) The PRISMA Statement for Reporting Systematic Reviews and Meta-Analyses of Studies That Evaluate Health Care Interventions: Explanation and Elaboration. *Journal of Clinical Epidemiology*, **62**, e1-e34. <https://doi.org/10.1016/j.jclinepi.2009.06.006>
- [20] Green, S., Higgins, J., Alderson, P., Clarke, M., Mulrow, C. and Oxman, A. (2008) Cochrane Handbook for Systematic Reviews of Interventions: Cochrane Book Series. The Cochrane Collaboration and John Wiley & Sons Ltd. <https://www.radioterapiaitalia.it/wp-content/uploads/2017/01/cochrane-handbook-for-systematic-reviews-of-interventions.pdf>
- [21] Godin, K., Stapleton, J., Kirkpatrick, S.I., Hanning, R.M. and Leatherdale, S.T. (2015) Applying Systematic Review Search Methods to the Grey Literature: A Case Study Examining Guidelines for School-Based Breakfast Programs in Canada. *Systematic Reviews*, **4**, Article No. 138. <https://doi.org/10.1186/s13643-015-0125-0>
- [22] Fraval, S., Hammond, J., Bogard, J.R., Ng'endo, M., van Etten, J., Herrero, M., Oosting, S.J., de Boer, I.J., Lannerstad, M. and Teufel, N. (2019) Food Access Deficiencies in Sub-Saharan Africa: Prevalence and Implications for Agricultural Interventions. *Frontiers in Sustainable Food Systems*, **3**, Article No. 104. <https://doi.org/10.3389/fsufs.2019.00104>
- [23] Waha, K., Van Wijk, M.T., Fritz, S., L. See, Thornton, P.K., Wichern, J. and Herroero, M. (2018) Agricultural Diversification as an Important Strategy for Achieving Food Security in Africa. *Global Change Biology*, **24**, 3390-3400. <https://doi.org/10.1111/gcb.14158>
- [24] de Graaff, J., Kessler, A. and Nibbering, J.W. (2011) Agriculture and Food Security in Selected Countries in Sub-Saharan Africa: Diversity in Trends and Opportunities. *Food Security*, **3**, 195-213. <https://doi.org/10.1007/s12571-011-0125-4>
- [25] Abdul Mumin, Y. and Abdulai, A. (2020) Informing Food Security and Nutrition Strategies in Sub-Saharan African Countries: An Overview and Empirical Analysis. *Applied Economic Perspectives and Policy*, **44**, 364-393.
- [26] Cordero Salas, P. and Chen, S.E. (2015) The Effect of Agricultural Diversification and Commercialization on the Anthropometric Outcomes of Children: Evidence from Tanzania. 2015 AAEA & WAEA Joint Annual Meeting, San Francisco, 26-28 July 2015, No. 205050. <https://ideas.repec.org/p/ags/aaea15/205050.html>
- [27] Bellon, M.R., Kotu, B.H., Azzarri, C. and Caracciolo, F. (2020) To Diversify or Not to Diversify, That Is the Question. Pursuing Agricultural Development for Smallholder Farmers in Marginal Areas of Ghana. *World Development*, **125**, Article ID:

104682. <https://doi.org/10.1016/j.worlddev.2019.104682>
- [28] Ayenew, H.Y., Biadgilign, S., Schickramm, L., Abate-Kassa, G. and Sauer, J. (2018) Production Diversification, Dietary Diversity and Consumption Seasonality: Panel Data Evidence from Nigeria. *BMC Public Health*, **18**, Article No. 988. <https://doi.org/10.1186/s12889-018-5887-6>
- [29] Namugumya, B.S., Candel, J.J., Talsma, E.F. and Termeer, C.J. (2020) Towards Concerted Government Efforts? Assessing Nutrition Policy Integration in Uganda. *Food Security*, **12**, 355-368. <https://doi.org/10.1007/s12571-020-01010-5>
- [30] Pernechele, V., Balié, J. and Ghins, L. (2018) Agricultural Policy Incentives in Sub-Saharan Africa in the Last Decade (2005-2016). Monitoring and Analysing Food and Agricultural Policies (MAFAP) Synthesis Study. Food and Agriculture Organization of the United Nations, Rome. <https://www.fao.org/publications/card/fr/c/I8997EN/>
- [31] Hollinger, F. and Staatz, J.M. (2015) Agricultural Growth in West Africa, Market and Policy Drivers. FAO, African Development Bank, ECOWAS. Pobrano październik.
- [32] Romeo, A., Meerman, J., Demeke, M., Scognamillo, A. and Asfaw, S. (2016) Linking Farm Diversification to Household Diet Diversification: Evidence from a Sample of Kenyan Ultra-Poor Farmers. *Food Security*, **8**, 1069-1085. <https://doi.org/10.1007/s12571-016-0617-3>
- [33] Ecker, O. (2018) Agricultural Transformation and Food and Nutrition Security in Ghana: Does Farm Production Diversity (Still) Matter for Household Dietary Diversity? *Food Policy*, **79**, 271-282. <https://doi.org/10.1016/j.foodpol.2018.08.002>
- [34] Nkonde, C., Audain, K., Kiwanuka-Lubinda, R.N. and Marinda, P. (2021) Effect of Agricultural Diversification on Dietary Diversity in Rural Households with Children under 5 Years of Age in Zambia. *Food Science & Nutrition*, **9**, 6274-6285. <https://doi.org/10.1002/fsn3.2587>
- [35] Asamane, E.A., Marinda, P.A., Khayeka-Wandabwa, C. and Powers, H.J. (2021) Nutritional and Social Contribution of Meat in Diets: Interplays among Young Urban and Rural Men. *Appetite*, **156**, Article ID: 104959. <https://doi.org/10.1016/j.appet.2020.104959>
- [36] Marinda, P.A., Genschick, S., Khayeka-Wandabwa, C., Kiwanuka-Lubinda, R. and Thilsted, S.H. (2018) Dietary Diversity Determinants and Contribution of Fish to Maternal and Under-Five Nutritional Status in Zambia. *PLOS ONE*, **13**, e0204009. <https://doi.org/10.1371/journal.pone.0204009>
- [37] Douyon, A., Worou, O.N., Diama, A., Badolo, F., Denou, R.K., Touré, S., Sidibé, A., Nebie, B. and Tabo, R. (2022) Impact of Crop Diversification on Household Food and Nutrition Security in Southern and Central Mali. *Frontiers in Sustainable Food Systems*, **5**, Article ID: 751349. <https://doi.org/10.3389/fsufs.2021.751349>
- [38] Heumesser, C. and Kray, H.A. (2019) Productive Diversification in African Agriculture and Its Effects on Resilience and Nutrition.
- [39] Lencucha, R., Pal, N.E., Appau, A., Thow, A.-M. and Drope, J. (2020) Government Policy and Agricultural Production: A Scoping Review to Inform Research and Policy on Healthy Agricultural Commodities. *Globalization and Health*, **16**, Article No. 11. <https://doi.org/10.1186/s12992-020-0542-2>
- [40] Bai, Y., Alemu, R., Block, S.A., Headey, D. and Masters, W.A. (2020) Cost and Affordability of Nutritious Diets at Retail Prices: Evidence from 177 Countries. *Food Policy*, **99**, Article ID: 101983. <https://doi.org/10.1016/j.foodpol.2020.101983>
- [41] Deijl, C., andersson Djurfeldt, A. and Jirström, M. (2017) Agricultural Policy in

- Sub-Saharan Africa and Its Relevance for Smallholder Farmers, Women and Youth: A Policy Baseline Report for Sub-Saharan Africa at the Continental, Regional and National Level.  
<https://agris.fao.org/agris-search/search.do?recordID=SE2022009409>
- [42] Molnar, G. and Godefroy, S.B. (2020) Review of Mechanisms for Food Safety-Related SPS Measures within African Regional Economic Communities (RECs): Paving the Way for a Continent-Wide Food Safety Coordination Effort. *Food Control*, **115**, Article ID: 107206. <https://doi.org/10.1016/j.foodcont.2020.107206>
- [43] Balié, J. and Ghins, L. (2017) Agricultural Policy Incentives in Sub-Saharan Africa in the Last Decade (2005-2016). FAO Agricultural Development Economics Technical Study (FAO) Eng, No. 3.
- [44] Oppong, R. (2010) The African Union, the African Economic Community and Africa's Regional Economic Communities: Untangling a Complex Web. *African Journal of International and Comparative Law*, **18**, 92-103.  
<https://doi.org/10.3366/E0954889009000528>
- [45] Nyaga, J.M., Onyango, C.M., Wetterlind, J. and Söderström, M. (2021) Precision Agriculture Research in Sub-Saharan Africa Countries: A Systematic Map. *Precision Agriculture*, **22**, 1-20. <https://doi.org/10.1007/s11119-020-09780-w>
- [46] Onyango, C.M., Nyaga, J.M., Wetterlind, J., Söderström, M. and Piikki, K. (2021) Precision Agriculture for Resource Use Efficiency in Smallholder Farming Systems in Sub-Saharan Africa: A Systematic Review. *Sustainability*, **13**, Article 1158.  
<https://doi.org/10.3390/su13031158>
- [47] Andersson Djurfeldt, A., Djurfeldt, G., Hillbom, E., Isinika, A.C., Joshua, M.D.K., Kaleng'a, W.C., Kalindi, A., Msuya, E., Mulwafu, W. and Wamulume, M. (2019) Is There Such a Thing as Sustainable Agricultural Intensification in Smallholder-Based Farming in Sub-Saharan Africa? Understanding Yield Differences in Relation to Gender in Malawi, Tanzania and Zambia. *Development Studies Research*, **6**, 62-75.  
<https://doi.org/10.1080/21665095.2019.1593048>
- [48] Shiferaw, B., Tesfaye, K., Kassie, M., Abate, T., Prasanna, B. and Menkir, A. (2014) Managing Vulnerability to Drought and Enhancing Livelihood Resilience in Sub-Saharan Africa: Technological, Institutional and Policy Options. *Weather and Climate Extremes*, **3**, 67-79. <https://doi.org/10.1016/j.wace.2014.04.004>
- [49] Hollinger, F. (2015) Agricultural Growth in West Africa, Market and Policy Drivers. Food and Agriculture Organization of the United Nations (FAO).  
[https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/Agricultural Growth in West Africa - Market and policy drivers - OSAN.pdf](https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/Agricultural_Growth_in_West_Africa_-_Market_and_policy_drivers_-_OSAN.pdf)
- [50] Sibhatu, K.T., Krishna, V.V. and Qaim, M. (2015) Production Diversity and Dietary Diversity in Smallholder Farm Households. *Proceedings of the National Academy of Sciences*, **112**, 10657-10662. <https://doi.org/10.1073/pnas.1510982112>
- [51] Jebessa, G.M., Sima, A.D. and Wondimagegnehu, B.A. (2019) Determinants of Household Dietary Diversity in Yayu Biosphere Reserve, Southwest Ethiopia. *Ethiopian Journal of Science and Technology*, **12**, 45-68.  
<https://doi.org/10.4314/ejst.v12i1.3>
- [52] Ekesa, B., Blomme, G. and Garming, H. (2011) Dietary Diversity and Nutritional Status of Pre-School Children from Musa-Dependent Households in Gitega (Burundi) and Butembo (Democratic Republic of Congo). *African Journal of Food, Agriculture, Nutrition and Development*, **11**, 4896-4911.  
<https://doi.org/10.4314/ajfand.v11i4.69141>



- [53] Shiundu, K.M. and Oniang'o, R.K. (2007) Marketing African Leafy Vegetables: Challenges and Opportunities in the Kenyan Context. *African Journal of Food, Agriculture, Nutrition and Development*, **7**, 1-17.  
<https://doi.org/10.18697/ajfand.15.IPGRI2-8>
- [54] Hena, L., Moyer, L. and Namakula, P. (2017) Africa 2030: How Africa Can Achieve the Sustainable Development Goals. Sustainable Development Goal Centre for Africa (SDGC/A), Kigali.
- [55] U. IFAD (2013) Smallholders, Food Security and the Environment. International Fund for Agricultural Development, Rome, 29.
- [56] AfDB (2016) Feed Africa Strategy.
- [57] A.D. Bank (2016) Feed Africa: Strategy for Agricultural Transformation in Africa, 2016-2025. African Development Bank Group, Abidjan.
- [58] Bello-Schünemann, J., Donnenfeld, Z., Aucoin, C., Cilliersand, J. and Porter, A. (2017) African Futures: Key Trends to 2035. *Journal of Futures Studies*, **23**, 127-140.  
<https://doi.org/10.2139/ssrn.3099362>
- [59] Burke, W.J. and Jayne, T. (2014) Smallholder Land Ownership in Kenya: Distribution between Households and through Time. *Agricultural Economics*, **45**, 185-198.  
<https://doi.org/10.1111/agec.12040>
- [60] Bayisenge, J., Höjer, S. and Espling, M. (2015) Women's Land Rights in the Context of the Land Tenure Reform in Rwanda—The Experiences of Policy Implementers. *Journal of Eastern African Studies*, **9**, 74-90.  
<https://doi.org/10.1080/17531055.2014.985496>
- [61] Fuglie, K. and Rada, N. (2013) Resources, Policies, and Agricultural Productivity in Sub-Saharan Africa. USDA-ERS Economic Research Report (145).  
<https://doi.org/10.2139/ssrn.2266459>
- [62] African Union (2014) Implementation Strategy and Roadmap to Achieve the 2025 Vision on CAADP. African Union, Addis Ababa.
- [63] Badiane, O., Odjo, S. and Ulimwengu, J. (2011) Emerging Policies and Partnerships under CAADP: Implications for Long-Term Growth, Food Security, and Poverty Reduction. International Food Policy Research Institute (IFPRI), Washington DC.
- [64] Lokosang, L., Osei, A. and Covic, N. (2016) The African Union Policy Environment toward Enabling Action for Nutrition in Africa, Achieving a Nutrition Revolution for Africa: The Road to Healthier Diets and Optimal Nutrition. Annual Trends and Outlook Report, 5-11.
- [65] A. Union (2015) Agenda 2063 Report of the Commission on the African Union Agenda 2063. The Africa We Want in 2063.
- [66] Mukasa, A.N., Woldemichael, A.D., Salami, A.O. and Simpasa, A.M. (2017) Africa's Agricultural Transformation: Identifying Priority Areas and Overcoming Challenges. *Africa Economic Brief*, **8**, 1-16.
- [67] Alagidede, I.P., Ibrahim, M. and Sare, Y.A. (2020) Structural Transformation in the Presence of Trade and Financial Integration in Sub-Saharan Africa. *Central Bank Review*, **20**, 21-31. <https://doi.org/10.1016/j.cbrev.2020.02.001>
- [68] Lachat, C., Nago, E., Ka, A., Vermeulen, H., Fanzo, J., Mahy, L., Wüstefeld, M. and Kolsteren, P. (2015) Landscape Analysis of Nutrition-Sensitive Agriculture Policy Development in Senegal. *Food and Nutrition Bulletin*, **36**, 154-166.  
<https://doi.org/10.1177/0379572115587273>
- [69] Bisoffi, S., Ahrné, L. and Aschemann-Witzel, J., *et al.* (2021) COVID-19 and Sustainable Food Systems: What Should We Learn Before the Next Emergency. *Fron-*

*tiers in Sustainable Food Systems*, **5**, Article 650987.

<https://www.frontiersin.org/articles/10.3389/fsufs.2021.650987/full>

- [70] Pepino, S. (2014) Nutrition, Education and Awareness Raising for the Right to Adequate Food. FAO, Rome.
- [71] Druilhe, Z. and Barreiro-Hurlé, J. (2012) Fertilizer Subsidies in Sub-Saharan Africa. ESA Working Paper No. 12-04. Food and Agriculture Organization of the United Nations, Agricultural Development Economics Division (ESA).  
<https://ideas.repec.org/p/ags/faoaes/288997.html>