Climate change adaptation and mitigation measures for nutrition co-benefits in IFAD investments in Ghana

Pre-Design Mission Report

Sanne Bakker, Ilse Hennemann, Samuel Dotse and Clement Kubuga

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This research was funded by 'Adaptation for Smallholder Agriculture Programme' (ASAP) Phase 2. International Fund for Agricultural Development (IFAD).

Wageningen Centre for Development Innovation
Wageningen, June 2021

Report WCDI-21-163

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S. Bakker, I. Hennemann, S. Dotse, C. Kubuga, 2021. *Climate change adaptation and mitigation measures for nutrition co-benefits in IFAD investments in Ghana; Pre-design mission report.* Wageningen Centre for Development Innovation, Wageningen University & Research. Report WCDI-21-163. Wageningen.

Keywords: Ghana, Climate adaptation, Climate mitigation, Nutrition, IFAD investments.

This report can be downloaded for free at https://doi.org/10.18174/547740 or at www.wur.eu/cdi (under publications).

Report WCDI-21-163

Photo cover: Hamish John Appleby. Flickr.

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Acknowledgements

We would like to express our appreciation to Dr. Daniel Tutu Benefoh, Dr. Antwi Bosiako-Amoah, Kingsley Amoako, Vincent Botchway, Foster Aboagye Gyamfi, Kawusada Abubakar, Wilfred Nelson, Rhoda Donkor, Loretta Baidoo, Flora Amaglo, Prof. Saa Dittoh, Dr. Edmund and his team, Alex Osei Yeboah, Fati Abdulai, Gloria Kobati, Abdul Fatawu, Joyce Antoinette Kulevo, Ruth Situma, Priscilla Wobil, Porbilla Ofosu-Apea, Jevaise Aballo and the Dakpenyili Soy Farmers' group, all of them for making themselves available on short notice to share their experiences and views and for their perseverance and determination to answer our questions despite the at times poor internet connections.

A special thanks to Hani Abdelkader Elsadani Salem, Faten Bokri, Swandip Sinha, and Jonathan Agwe who supported us in the shaping and contextualisation of this assignment by sharing their insights and feedback on several occasions. Our gratitude extends to the IFAD team, Ilaria Bianchi, Joyce Njoro and Liza Leclerc in Rome, who helped us with their valuable contributions and the overall coordination of this mission.

1 Introduction

1.1 Background

IFAD designed a project not long ago on the adoption of climate adaptation measures, which increase nutrition co-benefits for smallholder farmers and their families. The project is titled 'Climate change and nutrition in value chain development' and is funded under ASAP 2 (Adaptation for Smallholder Agriculture Programme - Phase II). The ASAP is IFAD's flagship programme for channelling climate and environmental finance to smallholder farmers and is incorporated into IFAD's regular investment processes, benefitting from rigorous quality control and supervision systems. The project aims to develop a tried and proven methodology and approach to support project designs/mid-term reviews as well as to strengthen the capacity of IFAD teams to conduct comprehensive and integrated assessments at project design that allow for the identification of adaptation and mitigation actions, while simultaneously reducing nutrition risks of food value chain investments.

In order to implement most of the activities of the above initiative, the provision of high quality technical support has been requested by IFAD from Wageningen Centre for Development Innovation (WCDI). WCDI support will allow IFAD to develop an integrated approach for designing climate-smart and nutrition-sensitive value chains, hereby contributing to the operationalisation of IFAD's transformational framework for mainstreaming themes and to reinforce capacities of local actors.

This technical support provided by WCDI includes the three pre-design studies for three projects, in three IFAD supported countries, namely:

- Project on Regeneration of Livelihoods Landscapes (P-ROLL) in Lesotho
- Smallholder Agriculture Cluster Project (SACP) in Zimbabwe
- Livelihood and Productivity Enhancement of Smallholder Farmers Project (PROSPER) in Ghana

This reports describes the findings and recommendations of the pre-design study for PROSPER in Ghana. PROSPER will be part of the Ghana Country Strategic Opportunities Programme (COSOP). This COSOP has three strategic objectives:

- Strategic objective 1: Promote a financially sustainable and inclusive rural transformation by: (i) fostering an enabling environment; (ii) improving the effectiveness of public expenditures in agriculture; and (iii) acting as an assembler of development finance.
- Strategic objective 2: Strengthen productivity in inclusive value chain development by enabling smallholder farmers, livestock keepers and fishers to: (i) improve access to technology and innovation; (ii) enhance access to improved production inputs and produce markets through use of certified seeds and agrochemicals; and (iii) bolster climate change resilience and natural resource management.
- Strategic objective 3: Strengthen capacities and economic opportunities by: (i) supporting the development of affordable, sustainable agricultural service providers; (ii) strengthening entrepreneurial, business and organisational management skills; and (iii) improving access to financial services.

The number of IFAD-financed programmes in Ghana is currently 4, namely, the Ghana Agriculture Sector Investment Programme (GASIP) under the Ministry of Food and Agriculture (MoFA), the Rural Enterprises Programme (REP) under the Ministry of Trade and Industry (MoTI), the Affordable Agricultural Financing for Resilient Rural Development Project under the Ministry of Finance, and the Emergency Support to Rural livelihoods and Food systems exposed to COVID 19 (ESRF).

1.2 Assignment objectives and scope

The objective of the pre-design mission has been formulated as:

To conduct a pre-design study mission for Ghana with the aim of exploring opportunities for climate adaptation and mitigation, and nutrition actions for future IFAD investments in Ghana (hereinafter: PROSPER).

Due to the COVID-19 crisis, this mission will be conducted in a remote manner.

The specific objectives of this mission are:

- To reflect on the lessons learned related to climate and nutrition in previous and current IFAD investments in Ghana and on their implications for the design of PROSPER.
- To assess to what extent the lessons and recommendations of the general literature review on food system interventions with climate and nutrition co-benefits, can be applied to the Ghanaian context.
- To review the main government and donor supported climate-nutrition initiatives and the pre-screening of potential partners for collaboration with PROSPER.
- To consult with selected key stakeholders to describe the present climate adaptation, mitigation and nutrition landscape, and validate proposed pathways and actions.
- To generally formulate appropriate pathways and suitable, sustainable, significant actions that effectively integrate climate and nutrition into IFAD's investments in Ghana (including strategies, processes and/or methodologies, if appropriate). Which are also capable to enrich IFAD's project designs with climate-nutrition linkages.
- To suggest feasible and concrete actions that can then be fully integrated into the design of PROSPER and flesh them out further.
- To conduct further literature review on approximately 5 pathways with actions selected by the Design Team. These will contain clear linkages to PROSPER's target groups and will explore possible synergies with ongoing projects such as GASIP, REP and AAFORD.
- To conduct field visits (if the situation allows) to understand the present living conditions of the rural poor and other IFAD target groups (by local consultants).
- To validate the findings from the study mission in a national level stakeholder workshop (online) to learn from each other and build consensus.
- To support the Design Team on challenges and issues related to integration of climate and nutrition into project design, which could be beneficial for the overall project goal and development outcome.
- To identify strategies that favour marginalised sub-sections of the population as key recipients of the interventions.

Detailed Terms of Reference can be found in Appendix 1.

1.3 Mission members

The pre-design mission team was comprised of the following members:

1. Ilse Hennemann, Advisor Environmental Governance & Climate Change, WCDI - Netherlands
2. Sanne Bakker, Advisor Food and Nutrition Security, WCDI – Netherlands
3. Samuel Dotse (PhD), Chief Executive Officer, HATOF Foundation - Ghana
4. Clement K. Kubuga (PhD), Nutrition Lecturer, Nutritional Sciences Department, University of Development Studies - Ghana

This team worked in close collaboration with the ECG Division (Ilaria Bianchi, Joyce Njoro, Liza Leclerc) and the IFAD Ghana country team (Hani Abdelkader Elsadani Salem, Faten Bokri, Swandip Sinha, and Jonathan Agwe).

1.4 Methodology

1.4.1 Literature review

A review of the literature and relevant reports was conducted by the team, including (secondary) sources provided by the IFAD Ghana team and ECG Division, as well as sources available online. Secondary sources included in this study are listed in the footnotes of this report.

Also, based upon the lessons learned from the general literature review (conducted between March 2020 and August 2020 under the project 'Technical support on climate change and nutrition linkages in IFAD's investments', Grant No 2000003246.) – the team explored which of the lessons learned can be applied within the Ghanaian context.

1.4.2 Key informant interviews

The pre-design team was not able to travel to Ghana because of the COVID-19 pandemic and instead conducted remote interviews with selected key stakeholders through WhatsApp, Skype and/or 'Zoom' meetings. The initial selection of stakeholders was done in consultation with the IFAD country team representative and the local consultants. Stakeholders of interest were selected based on their roles and responsibilities in climate and/or nutrition, as well as their understanding of climate and/or nutrition issues in the areas targeted by PROSPER. In total, the team conducted interviews with 16 stakeholders and soy farmer groups over a three-week period. A list of the stakeholders who have been interviewed, and their details, can be found in Appendix 6.

The team developed a topic interview guide based on IFAD guidance materials on the mainstreaming themes (Environment and Climate, Gender, Nutrition and Youth), the PROSPER concept note[1], the COSOP 2019-2024 for Ghana, and other documents included in the literature review (see previous section). The topic guide was tailored to the interviewees' areas of expertise.

[1] Version shared with the pre-design mission team on 22 October.

2 Key lessons learned

The following key lessons learned for nutrition and climate are based on project reports for IFAD projects and other climate and/or nutrition-related projects in Northern Ghana, consultation with key informants working on these types of projects, as well as empirical evidence examining the impacts of interventions on climate and/or nutrition outcomes:

- Improvements in the quality and quantity of produce do not necessarily lead to improved household nutrition as farmers involved in projects targeting increased quality and quantity of agricultural production, tend to sell their entire harvest, only to purchase inferior quality foods for home consumption. There is therefore a need to adapt behaviour towards home consumption of quality produce and utilising income to complement produce with foods required for a diversified and balanced diet (IFAD GASIP).
- Targeted crops should be evaluated for acceptability with farmers and traders before full scale implementations. There should be more than one target crop, so that farmers get to choose the most suitable one, and to prevent the feeling of imposition (MoFA/ADB).
- The Participatory Technology Development approach has worked as a community and farmer empowerment strategy for achieving sustainable food security and poverty reduction in Northern Ghana (ACDEP and CHF - Canada).
- Empirical evidence of Northern Ghana shows that increased productivity and on-farm production diversity positively affect household dietary diversity, with the effect of the latter becoming more pronounced the longer the distance to the nearest daily market. Yet, the larger the share of food consumption that comes from own production, the lower the dietary diversity. On-farm production alone is insufficient to ensure quality diets, despite its positive contribution.
- The same studies confirm that women's education and responsibility within the household have a significant positive effect on household dietary diversity, suggesting the importance of incorporating gender dimensions into interventions that aim to promote nutrition security[2].
- Climate-Smart Agriculture (CSA) practices should not be limited to production alone. In order to promote upscaling, more investment in CSA practices for the processing and marketing segments of value chains are required. Especially for targeting women as they are relatively more engaged in the processing and marketing of commodity value chains (FAO & MoFA).
- Standalone CSA practices are not sufficiently contributing to increased yields, nutrition benefits and climate resilience. Their strength lies in crop and livestock diversification and therefore the adoption of integrated systems (combined CSA practices and with additional sustainable land, possibly management practices) is recommended (FAO, MoFA, IFAD literature review).
- Men and religious groups in communities can become effective agents of change in the economic empowerment of women within patriarchal cultures (MEDA, SOCODEVI).
- Future projects that involve credit schemes should have a continuous capacity-building component that targets potential beneficiaries and financial institutions. Beneficiaries should be trained on credit, bookkeeping, accounting, and financing; and should be assisted in making effective investments. The need also exists to establish a well-understood system of loan repayment to be put in place to build trust among project beneficiaries and developers. Other projects can learn from the use of grants approach where funds were disbursed to about 43 NGOs to implement livelihood components (UNDP, Ministry of Environment, Science, Technology and Innovation).

[2] Signorelli, Sara; Haile, Beliyou; and Kotu, Bekele. 2017. Exploring the agriculture-nutrition linkage in Northern Ghana. IFPRI Discussion Paper 1697. Washington, D.C.: International Food Policy Research Institute (IFPRI).

3 Situation analysis

3.1 Nutrition situation

Figure 1 illustrates the significant regional disparities concerning nutrition security in Ghana. The Northern region is worse off when it comes to (extreme) rural poverty, rural child stunting and the prevalence of anaemia among women and children. Food insecurity is a major contributing factor to the poor nutritional status of the population in the northern regions of Ghana. Child stunting levels are higher for children whose mothers had no formal education and for children in the lowest wealth quintile. The national child wasting rate stands at 7%, with the highest prevalence reported for Northern Ghana (10.9%)[6].

Despite the progress on other nutrition targets, anaemia - as a result of inadequate intake of iron, malaria and intestinal worm infestation - continues to be an urgent public health problem in Ghana, affecting children and women throughout the course of their lives. There has been a modest decline in the prevalence of anaemia in children between 2008 and 2014, but this decline tended to disproportionately benefit less vulnerable groups (children of lowest wealth quintile and of mothers without education). Likewise, there was a high level of diversity in decline among regions: in the Northern region child anaemia rates stagnated, whereas in the Ashanti region rates declined by 31%[3]. Iodine deficiency affects about 50% of all non-pregnant women[4]. The iodine-poor soils in Northern Ghana pose an additional challenge to increase iodine intake. About 20% of children in Ghana suffer from Vitamin A deficiency, with a higher prevalence in Ghana's northern belt (31%)[5]. Low iron fortification levels of staples and oil, coupled with diets low in iron and provitamin A carotenoids, are considered important reasons for the high prevalence of anaemia and vitamin A deficiencies in Ghana[6].

Overweight is affecting more women than men in Ghana; of women, 25% are overweight and 14% obese, versus 18% overweight men and 4% obese. The prevalence of overweight/obesity is almost double in urban areas compared to rural areas, and is strongly associated with socio-economic status. The rate of overweight children is low at 1%[7]. There is a substantial gap in nutrition and dietary intake data for adolescents.

[3] SPRING, Ghana Health Service. 2016. Ghana: Landscape Analysis of Anemia and Anemia Programming. Arlington, VA: Strengthening Partnerships, Results, and Innovations in Nutrition Globally (SPRING) project.

[4] 2015 National Iodine Deficiency Survey Ghana.

[5] UNICEF 2017.

[6] Ghana micronutrient survey 2017.

[7] MICS 2017-2018.

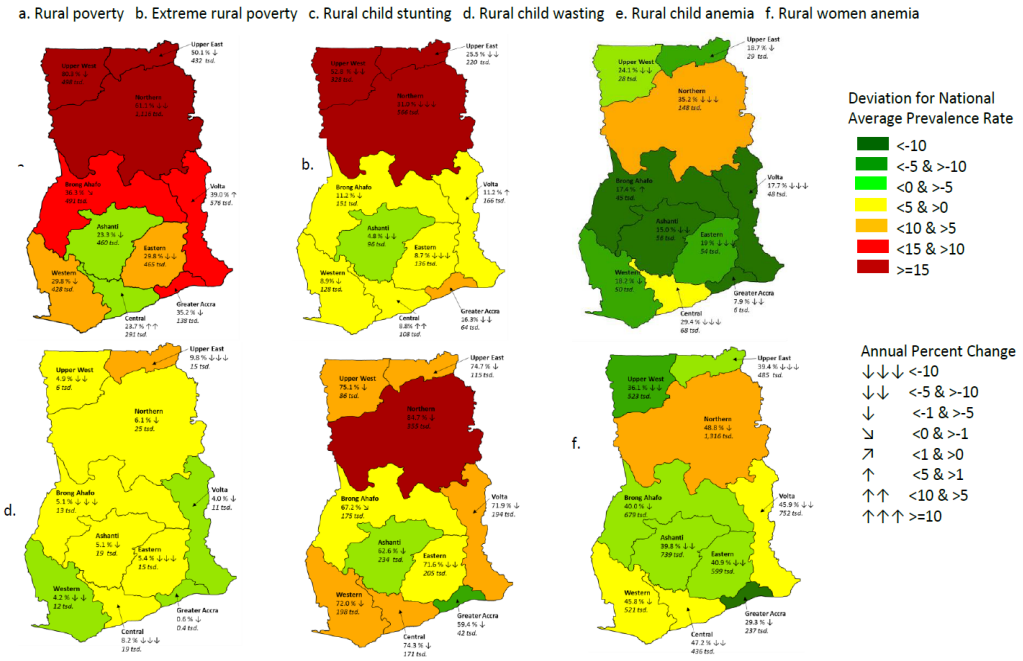

Figure 1 *Deviation from national prevalence rates. Prevalence rate (%), Annual percent change (pc.), Number of poor/malnourished individuals (tsd.)*[8].

3.1.1 Main underlying causes of malnutrition

Food security and consumption patterns

The latest food security and nutrition monitoring updates of WFP, dated June 2020, reported that, when using the Food Consumption Score as a proxy for food security, of the total number of households surveyed (n=1600), 91.5% were considered food secure, i.e. within the acceptable food consumption group, while 7.7% and 0.8% were moderately food insecure (borderline) and severely food insecure (poor), respectively. According to the survey, moderately and severely food insecure households were from the Bono, Bono East, Northern, Oti and Ashanti regions. A quarter (24.2%) adopted one or more coping strategies to deal with lack of food or money to buy food during the month of June, including relying on less preferred or less expensive foods, borrowing from relatives and friends, limiting or reducing the portion or size of meals, restricting consumption by adults in order for small children to eat, and reducing the number of meals eaten in a day. The majority of the respondents had physical access to markets, however, the lack of money (62.9%), the COVID-19 pandemic (22.2%) and closure of markets and shops (5.6%) were cited as the main reasons for households' inability to access the market or grocery shops[9].

This is in line with the findings from the interviews with key informants, as, in their view, the greatest barriers to household food security in PROSPER targeted areas are food availability and affordability. Food **availability** is hampered by crop failure and reduced livestock productivity due to droughts, floods, higher incidences of pests and diseases and degraded farmlands. People in the North rely mostly on staples and tubers. The availability of fruit and vegetables for instance is highly seasonal, with the peak season occurring between June and September. Furthermore, urban settings tend to have better transportation, modern supermarkets and cold storage facilities thereby helping to increase the stock of fruit and vegetables in those areas[10].

[8] Ecker, O., & van Asselt, J. (2017). Food and Nutrition Security in Transforming Ghana A Descriptive Analysis of National Trends and Regional Patterns (IFPRI Discussion Paper Series No. 01650). Washington D.C.

[9] Unfortunately, the FSNMS report does not disaggregate data on FCS and coping strategies. The only reports with disaggregated that could be identified during this mission are rather outdated.

[10] Amo-Adjei J, Kumi-Kyereme A. Fruit and vegetable consumption by ecological zone and socioeconomic status in Ghana. J Biosoc Sci. 2015 Sep;47(5):613-31.

The lack of **access** to affordable nutritious foods is one of the main causes of poor diets. Seasonality in particular affects access to diverse diets for the poorest households who rely on their own food production. The cost of diet analysis done by the WFP calculated the lowest costs of locally available diet that meets nutrient requirements - when constrained for locally preferred staples. The regional unavailability of this diet ranged from 10% (Greater Accra) to 78% (Northern Region), with correlation between unaffordability and stunting prevalence. During lean season, food prices rise, especially in the North[11]. The vegetables perceived to be local (kontomire, okro, Roselle, garden eggs) seem to be the most affordable, while the vegetables that are perceived as foreign or exotic (lettuce, cabbage, cucumber, cauliflower, beetroot) are more expensive[12]. Research conducted in 3 agro-ecological zones in Ghana shows that livestock allows savings, enables resource-poor households to amass assets, and helps fund planned and unplanned spending (e.g., school fees and illness). Due to these various and often critical uses, direct consumption of home-reared animal source food is not a major priority, especially for poor households[13]. In addition, access to markets is affected by frequent flooding obstructing roads and bridges to markets[14].

Ghana's micronutrient survey of 2017 reports that national proportion of (non-pregnant) women achieving minimum dietary diversity[15] is 47.2%, with a consumption of 4.4 food groups[16] on average. Other studies in a sample of pregnant women in Northern Ghana showed that 46.1% consume the minimum dietary diversity[17], and, among a sample of women attending ante and post-natal care, the average number of food groups was reported at 4.3 groups[18].

Figure 2 below presents the per capita intake of different food groups for Ghana.

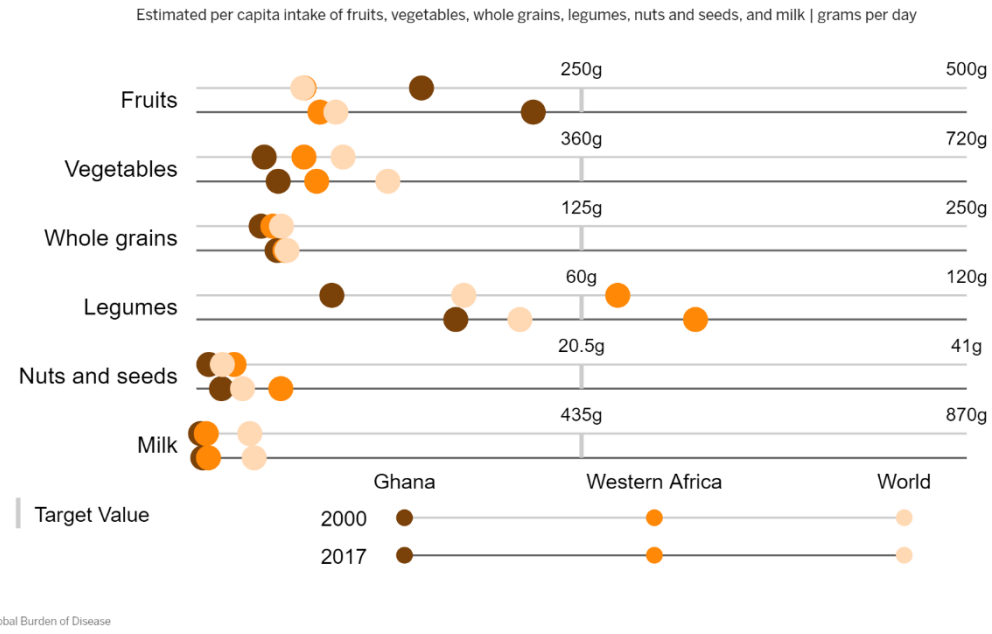

Figure 2 *Estimated per capita intake of fruits, vegetables, whole grains, legumes, nuts, and seeds, and milk (grams per day)[19].*

[11] WFP GHS Fill the nutrient gap Ghana. Summary report. 2016.
[12] HortiFresh 2019 Research report Vegetable consumption.
[13] Hanson Nyantakyi-Frimpong, Esi K. Colecraft, Raphael Baffour Awuah, Leonard Kofi Adjorlolo, Mark L. Wilson, Andrew D. Jones, Leveraging smallholder livestock production to reduce anemia: A qualitative study of three agro-ecological zones in Ghana, Social Science & Medicine, Volume 212, 2018, Pages 191-202.
[14] According to key informants at UNICEF and WFP.
[15] At least 5 out of 10 defined food groups.
[16] Ghana Micronutrient survey 2017.
[17] Saaka et al. 2016.
[18] Abubakari et al. 2016.
[19] Global burden of disease.

Care and feeding practices

Another major underlying cause of malnutrition are suboptimal infant and young child feeding practices. Rates of exclusive breastfeeding have decreased by 17% between 2008 and 2014, and further declined by 7% between 2014 and 2017. Generally, exclusive breastfeeding rates are higher in rural and poorer households [20,21,22,23]. The percentage of children fed with minimum dietary diversity is only 23% in the Northern region and 21% in the Upper East region. Figure 3 below, shows the inequities when it comes to minimum dietary diversity for children under 2. Most vulnerable are younger children (6-8 months) living in rural areas, in families of the poorest wealth quintile and whose mothers have a low education level.

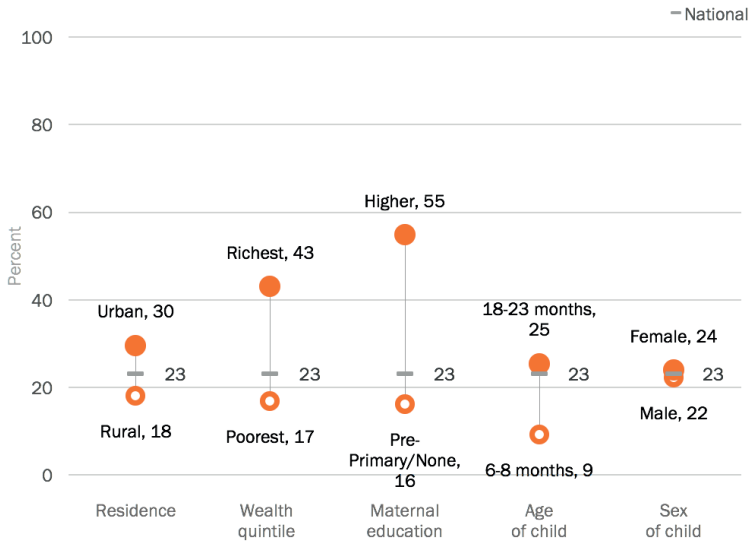

Figure 3 *Percent of children aged 6-23 months that were fed with minimum dietary diversity[24].*

An analysis of time use patterns of men and women in Ghana by FAO showed that, when compared to male workers, female workers face more constraints in allocating their time between productive activities and domestic activities. While 65% of men spend between 0 to 10 hours per week on domestic activities, 89% of women spend 10 hours per week or more. Meanwhile, women spend almost the same amount of time as men on productive activities. The most time-consuming activities for women are cooking and caring for household members: 11 and 10 weekly hours on average. Young rural women, aged 15 to 24, shoulder a larger domestic and productive workload than young men. For example, where almost two thirds of young rural men spend between 0 and 10 weekly hours on domestic work, over a quarter of young rural women spend 50 hours or more on domestic work. The allocation of roles and responsibilities in the household is defined from childhood as girls work longer hours than boys in domestic activities and are also more active in productive activities particularly between 12 and 14 years of age[25].

Environmental health and access to health services

Drying threatens the quantity and quality of water available for irrigation (food production) and Water, Hygiene and Sanitation (WASH) practices, which are key to nutrition. The MICS 2017-2018 shows that Ghana's regions that are hydrologically challenged, such as the Northern, Upper East and Upper West regions, are now evidently noticeable as having lower than national average access to basic water (improved water within 30 minutes). Only one in every five households in Ghana have an improved sanitation facility for their household, with the lowest percentages reported for the Northern, Upper East and Upper West region.

[20] GDHS 2014, GDHS 2017.
[21] MICS 2017 -2018.
[22] GDHS 2008.
[23] GDHS 2014.
[24] MICS 2017-2018.
[25] FAO. Gender inequalities in rural employment in Ghana. An overview. 2012.

In Ghana, diarrhoea is still a common childhood disease, which accounts for 25% of mortality in children under five years of age, with more than 9 million episodes occurring every year. Diarrhoea is a major cause of malnutrition, and generates an indirect cost as children caretakers are absent from work to stay in the hospital with their sick child[26]. The MICS 2017-2018 reports that care seeking for children with diarrhoea is higher for children living in rural areas, and for children of mothers with a higher education level. An analysis of different determinants that contribute to the occurrence, distribution and spread of diarrhoea among children below five years of age in Ghana concluded that the most important determinants are maternal education, lifestyle, employment, water and sanitation[27].

Figure 4 below shows the disparities in coverage of maternal and new-born care cascade between mothers in rural and urban areas. The largest disparities between rural and urban are marked for birth with skilled attendance or delivery in a health care facility. The Northern region perform systematically lower on the indicators for maternal and new-born cascade care as compared to national averages, especially when it comes to skilled birth attendance (60% in the North versus 79% at the national level) and institutional delivery (57% versus 78% at the national level).

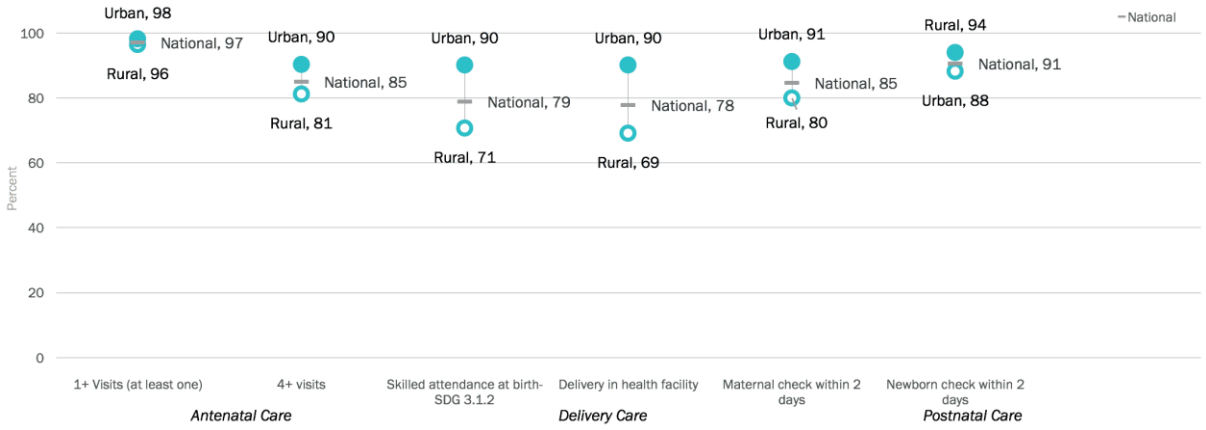

Figure 4 *Maternal and new-born health cascade[28].*

Among the key health challenges in Ghana are also communicable diseases, such as malaria, tuberculosis, and HIV, many of which are expected to become increasingly severe with climate change. Studies show that Malaria, diarrhoea, and Cerebral Spinal Meningitis are being aggravated by impacts of climate change in Ghana[29].

3.1.2 Gender & Nutrition

Another major risk factor for malnutrition is young age at first pregnancy, for both mother and child. The GDHS 2014 reports that, by the age of 19, 36% of adolescents have begun childbearing. Children of younger mothers could be more vulnerable to malnutrition because of physiological immaturity, social and psychological strain as a result of giving birth at a young age. Furthermore, concentration index analysis of GDHS data to assess inequality of children's height-for-age z-scores across socioeconomic distribution and contributing factors showed that maternal education was lowering childhood malnutrition in marked ways. In addition to the role of education to generate income to buy food, it is expected that a high level of maternal education could also improve child nutrition through

[26] Ameyaw R, Ameyaw E, Acheampong AO, et al. Diarrhoea among Children Under Five Years in Ghana. Glob J Res Rev. 2017, 4:2.
[27] Idem.
[28] MICS 2017-208.
[29] GIZ. Climate Risk Profile: Ghana.

other routes, for instance, increased awareness of healthy behaviour, sanitation practices and a more equitable sharing of nutritional resources favouring herself and the children[30].

3.1.3 COVID-19 & Nutrition

COVID-19 has impacted the underlying causes of malnutrition. The latest FSNMS of WFP (June 2020) captured the early-on impact of the COVID-19 pandemic and related measures on food and nutrition security by comparing June 2020 data to data from June 2019. The survey's findings indicate that (i) Utilisation of Child Welfare Clinics for growth monitoring has reduced (ii) Affordability remains the key issue (the increase in food prices varies across the foods, most affected foods are eggs, fruit, plantain and cassava) (iii) Smallholder farmers are limited in the types of alternative income generating activities to complement their food security needs[31]. Just as climate change, COVID-19 is seen as a threat multiplier for food and nutrition security. This calls for combined action – climate-smart and corona-smart actions.

3.1.4 Nutrition policy landscape and main stakeholders

Ghana's commitment to improving nutrition is outlined in the following policy documents, which are aligned with the Government's Vision 2020:

- Ghana Shared Growth and Development Agenda (GSGDA) II (2014–2017)
- The Coordinated Program for Economic and Social Development Policies (2017–2024)
- National Nutrition Policy 2016
- National Policy for the Prevention and Control of Chronic Non-Communicable Diseases in Ghana
- Medium Term Agriculture Sector Investment Plan (METASIP) (2010–2015)
- Food and Agriculture Sector Development Policy (FASDEP II) (2007)

The policy atlas for food and nutrition security prepared by SNV Ghana and IFPRI, has identified the regions and districts of Ghana with the poorest nutritional outcomes, and prepared an inefficiency profile for different regions in Ghana based on indicators related to agricultural potential, food production, food acquisition and nutrition outcomes for these districts. This analysis helps to decide whether districts/regions would benefit most from efficiency improvements in production, access or utilisation. The causes behind Ghana's hidden hunger depend both on geographic location, the type of micronutrient, and corresponding food sources that supply that micronutrient. To address micronutrient deficiencies, policy interventions should be geographically-sensitive and tailored to specific foods[32].

The main stakeholder for nutrition interventions in (Northern) Ghana have been mapped as part of this mission. An overview of the stakeholders, their interventions, partners, activities, target groups, and lessons have been included in Appendix 5.

At the national level, nutrition activities are coordinated by the Family Health Division. Nutrition has no division on its own. The head of nutrition reports to the Director of Family Health Division who in turn reports to the Director General of Health Services. At the regional level, nutrition activities are coordinated by the Public Health Division, as nutrition is the responsibility of the Public Health Division. The Regional Nutrition Officer reports to the Deputy Director of Public Health who reports to the Regional Director of health. At the district level, nutrition activities are coordinated by a Nutrition Unit. The head of the unit (District Nutrition Officer) reports to the District Director of Health who in turn reports to the Regional Director of Health. At the sub-district level, nutrition activities are coordinated by the Sub-district Nutrition Officer who reports to the Sub-district head. The Sub-district head then reports to the District Director of Health[33].

[30] Van de Poel, E., Hosseinpoor, A.R., Jehu-Appiah, C. et al. Malnutrition and the disproportional burden on the poor: the case of Ghana. Int J Equity Health 6, 21 (2007). https://doi.org/10.1186/1475-9276-6-21.

[31] Monitoring report of the Food Security and Nutrition Monitoring System (FSNMS).

[32] SNV & IFPRI. Ghana Policy Atlas on Food and Nutrition Security. 2020.

[33] As reported by key informants.

For the subnational level planning, implementation, and monitoring of nutrition-related programmes and activities, the National Nutrition Policy 2016 envisions that the Regional Planning and Coordination Unit, and District Planning Coordination Unit coordinate a technical team (comprising CSOs, private sector and other relevant institutions). However, according to key informants, these teams are dormant.

Ghana has a national level multi-stakeholder platform (MSP) for nutrition; the Nutrition Cross-Sectoral Planning Group (CSPG). The CSPG works under the auspices of the National Development Planning Commission (NDPC). The three northern regions have regional nutrition MSPs, and plans are in place to roll out the MSPs to all regions and districts[34]. The SUN Networks are up and running, except for the SUN Business network, which is currently in the process of setting up. Ghana's first lady Rebecca Akufo-Addo, has joined the African Leaders for Nutrition Initiative as a Nutrition Champion since 2019[35].

3.2 Climate Situation

Ghana can be divided into several agro-ecological zones (see Figure 5) from the dry and hot in the north, savannah and transitional zone in the centre to the humid rainforests and coastal savannah in the south. Ghana is divided into six agro-ecological zones on the basis of its climate. The natural vegetation is determined by the different climatic conditions and influenced by different soil types. These agro-ecological zones from north to south include: Sudan Savannah Zone, Guinea Savannah Zone, Transition Zone, Deciduous Forest zone, Rain (evergreen) Forest Zone and the Coastal Savannah Zone (see Figure 5).

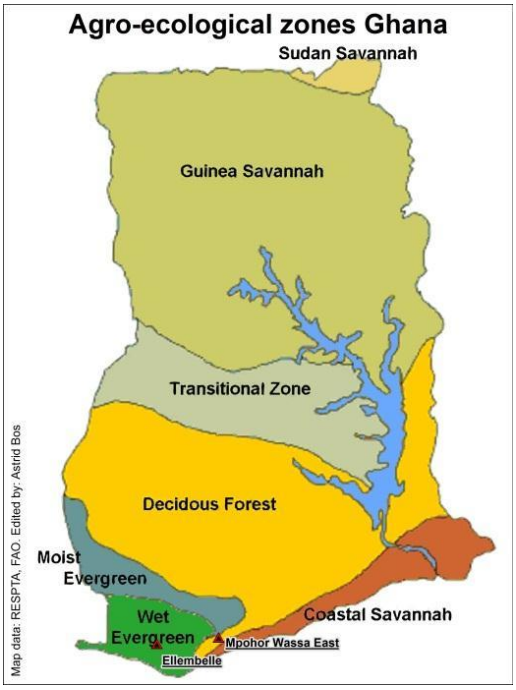

Figure 5 *Agro-ecological Zones Ghana map (FAO, 2012).*

Ghana has a tropical climate with annual rainfall ranging from 1100 mm in the north to about 2100 mm in the southwest[36]. The country has different rainy seasons: the north has one rainy season that extends from May to September and the south has two rainy seasons – the first lasts from April to July and the second from September to November. During the dry season, the country experiences

[34] National Nutrition Policy 2016.

[35] https://scalingupnutrition.org/news/ghanas-first-lady-joins-network-of-african-leaders-for-nutrition-champion/

[36] USAID. 2017. Climate Change Risk Profile Ghana.

low humidity and arid, dusty winds from the Sahara Desert. The days are hot, especially in the North and the nights are cool. An area covering the Guinea Savannah up to the forest zone in the southwest is the important domestic food production zone, due to reliable rainfall and a long growing season[37].

3.2.1 Climate projections

Ghana is already experiencing increased extreme weather conditions such as more prolonged droughts and floods[38]. Climate projections indicate temperatures will further increase. Mean annual temperature is expected to increase by 1.0°C - 3.0°C by 2060, with changes expected to be more severe in the north, see Figure 6. Long-lasting heat waves are expected to increase, potentially causing even more severe droughts[39].

Projections for rainfall patterns are less predictable, but overall the extremes in the wet and dry seasons are likely to increase: more intense and erratic precipitation during the wet season and lower precipitation levels during the dry season, see also Figure 7. In the North, there may be a delayed onset of the wet season resulting in a shortened growing season. Moreover, the intensity of heavy rains and floods is expected to further increase[40].

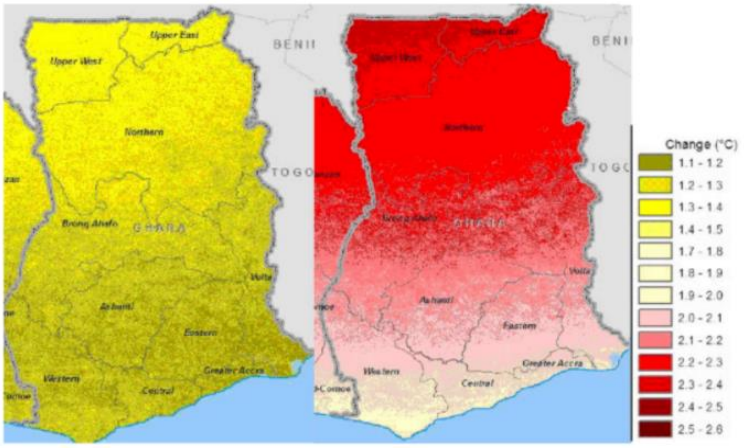

Figure 6 *Predicted temperature changes. 2030 (left) and 2050 (right) compared to 2010[41].*

[37] Idem.
[38] Ministry of Foreign Affairs of the Netherlands. 2018. Climate Change Profile Ghana.
[39] USAID. 2011. Ghana Climate Change Vulnerability and Adaptation Assessment.
[40] Ministry of Foreign Affairs of the Netherlands. 2018. Climate Change Profile Ghana.
[41] Ministry of Foreign Affairs of the Netherlands. 2018. Climate Change Profile Ghana.

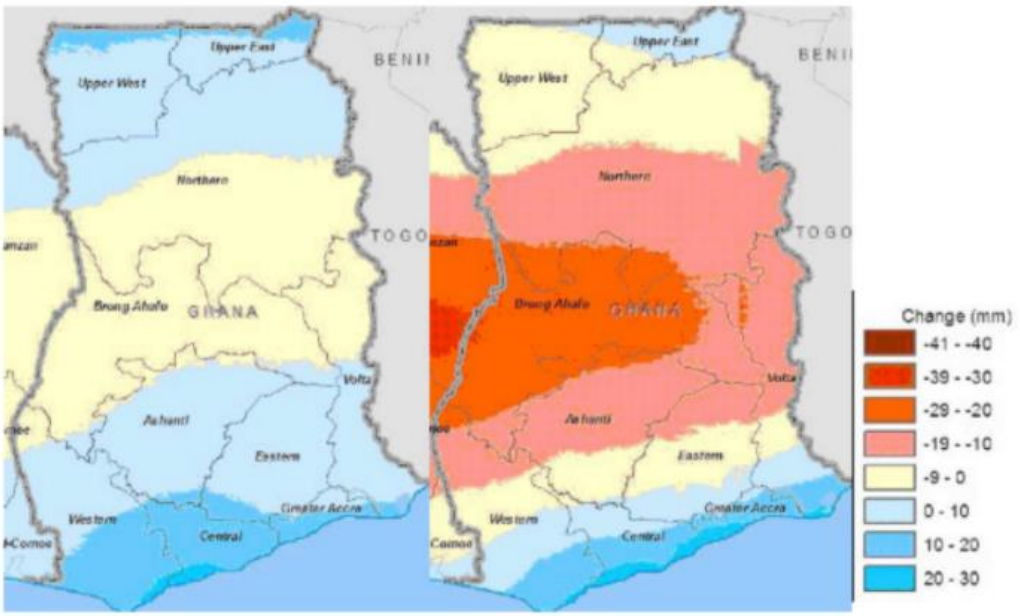

Figure 7 *Predicted precipitation changes, 2030 (left) and 2050 (right) compared to 2010*[42]*.*

Climate projections reveal that the agro-ecological zones of Ghana will be affected differently by climate change and variability. This spatial variability is summarised by USAID[43]. For the areas targeted by PROSPER, the USAID assessment includes the following projections:

- ***'Kumasi (Deciduous Forest Zone):*** *Forecasted changes in precipitation range from 48 percent decreases to 45 percent increases in wet season rainfall by 2080. The variability among the models' precipitation changes is not much different than the inter-annual variability currently experienced in the region. The A2 scenario, which generally shows the largest greenhouse gas (GHG) impact, predicts the weakest increase in wet season rainfall, 1.13 percent.*
- ***Techiman (Forest-Savanna Transition Zone):*** *Forecasted changes in precipitation range from 46 percent decreases to 36 percent increases in wet season rainfall. The variability among the models' precipitation changes is not much different than the inter-annual variability currently experienced in the region. The A2 scenario, which generally shows the largest GHG impact, predicts the largest decrease in wet season rainfall, -2.94 percent.*
- ***Tamale (Guinea Savanna Zone):*** *Forecasted changes in precipitation range from 36 percent decreases to 32 percent increases in wet season rainfall. The variability among the models' precipitation changes is not much different than the inter-annual variability currently experienced in the region. The Northern Region where Tamale is located is the southern-most region in Ghana to show a consistent trend toward decreased rainfall.*
- ***Walembelle (northern Guinea Savanna Zone):*** *Forecasted changes in precipitation range from 25 percent decreases to 24 percent increases in wet season rainfall. The variability among the models' precipitation changes is not much different than the inter-annual variability currently experienced in the region.*
- ***Bawku (Sudan Savanna Zone):*** *Forecasted changes in precipitation range from 28 percent decreases to 30 percent increases in wet season rainfall. The variability among the models' precipitation changes is not much different than the inter-annual variability currently experienced in the region.'*

3.2.2 Climate Change impacts

Despite Ghana only contributing 0.07% of global greenhouse gas emissions[44], the country is highly vulnerable to climate change based on the ND-GAIN index4 for climate vulnerability[45]. A country's ND-

[42] Ministry of Foreign Affairs of the Netherlands. 2018. Climate Change Profile Ghana.
[43] USAID. 2011. Ghana Climate Change Vulnerability and Adaptation Assessment.
[44] Ministry of Foreign Affairs of the Netherlands. 2018. Climate Change Profile Ghana.
[45] ND Gain Index. 2016. https://gain.nd.edu/our-work/country-index/Ghana.

GAIN index score is composed of a **vulnerability score** (a country's exposure, sensitivity and ability to adapt to the negative impact of climate change) and a **readiness score** (a country's ability to leverage investments and convert them to adaptation actions). Ghana has a vulnerability score of 0.466 (2018) with the most vulnerable sectors being: human habitat (0.645) food (0.561), health (0.503) and a readiness score of 0.353. This relatively high vulnerability score and low readiness score, ranks Ghana as the 70th most vulnerable country.

The **agricultural sector** in Ghana is experiencing spatial and seasonal climatic variability which impacts each agro-ecological zone differently. The most vulnerable regions are located in the North of Ghana. Ghanaian agriculture is mainly rain-fed with only 4% of its irrigation potential developed[46]. Combined with low levels of diversification and poverty rates, mainly smallholder farmers are vulnerable to crop failure caused by droughts, floods, higher incidences of pests and diseases and degraded farmlands. The four key food crops by harvest area in the country are maize, cassava, groundnuts and sorghum. A recent study on the **crop suitability** of these four crops concludes that drought stress and related plant water availability are the biggest climate-related constraints in Ghana[47]. These will lead to an overall reduction in the suitability of multiple crops under climate change. Areas which are currently suitable for crop production will decrease, leaving farmers with less crop choice for production, thus increasing their vulnerability even further. Main conclusions of this study on crop suitability are (see also Appendix 1 for detailed maps)[48]:

- **Groundnut** is the most climate resilient and shows the smallest loss in suitable growing areas. As a legume, it requires short growing periods and its nuts grow below the soil. The nuts may be protected from the direct effects of warming.
- **Maize:** the highest climate risk crop is maize, while also being the most planted area-wise and the highest net consumption in the country. Maize is relatively more sensitive to weather variables (higher temperature, droughts, extreme weather events).
- **Sorghum:** remains a high potential crop under a changing climate, especially in the north of Ghana. This underlines the importance of sorghum as it is already a major food crop and it remains suitable in a region where productive areas will further decrease.
- **Cassava:** is mostly suitable in the southern forested zones with high rainfall, however, modelling shows that by the 2050s, optimally suited areas for cassava will decrease by 7% (RCP2.6). This has largely to do with changes in precipitation-based factors.

High potential crop combinations: sorghum & groundnuts for the north and maize & groundnuts for the south should have the highest potential under climate change. This can be taken into account for future investments and adaptation planning.

3.2.3 Climate change & Land degradation

Agro-ecological landscapes across Ghana are severely degraded by climate drivers, but also by non-climate drivers. In 2010, 5.4 million Ghanaians were living on degraded agricultural land, which increased by 26% in a decade[49]. Degradation of these landscapes impacts rural livelihoods by reducing food availability, soil fertility, carbon sequestration capacity, wood production, groundwater recharge and more. Regarding tree cover loss, Ghana, lost 8% of humid primary forest from 2002 to 2019[50]. Deforestation rates in the Southwest of Ghana are the highest. Important drivers of land degradation and deforestation in Ghana consists of land use conversions, industrial mining, overharvesting, trafficking of wild animal and plant species, illegal logging, urbanization, and infrastructure development, invasive alien species and wildfires[51]. Land use conversions can be subdivided into: Commodity-driven deforestation associated with commercial agricultural expansion, but also shifting agriculture associated with small and medium-scale agriculture.

[46] Ministry of Foreign Affairs of the Netherlands. 2018. Climate Change Profile Ghana.
[47] Chemura et al. 2020. Impacts of climate change on agro-climatic suitability of major food crops in Ghana.
[48] Idem.
[49] Global Mechanism of the UNCCD, 2018. Country Profile of Ghana. Investing in Land Degradation Neutrality: Making the Case. An Overview of Indicators and Assessments.
[50] Global Forest Watch. 2020. Ghana.
[51] CBD. 2020. Ghana.

Areas and their inhabitants exposed to land degradation also become more vulnerable to climate-related shocks, leading to further reductions in the effectiveness of adaptation measures[52].

Climate change can exacerbate the ongoing rapid land degradation and desertification e.g. through soil erosion, droughts, changes in biodiversity and increase in pests & diseases. Climate adaptation planning for agriculture should therefore actively include ways to combat land degradation as degradation often increases the exposure and sensitivity of agro-ecological landscapes to climate impacts.

On the other side, land degradation also contributes to Greenhouse gas (GHG) emissions. The Agriculture, Forestry and Other Land Use (AFOLU) sector is the most important source of GHG emissions in Ghana, responsible for 71% of the total emissions of the country in 2012[53]. Protecting and restoring terrestrial ecosystems will not only reduce emissions, but they also play an important role as carbon sinks. This calls for combatting land degradation to contribute to climate adaptation as well as cost-effective mitigation options.

3.2.4 Gender, Youth & Climate

Women and men are affected differently by climate change due to gender inequalities in access and control over resources such as education, credit, technologies and public participation. In numbers, Ghanaian women produce 70% of the subsistence crops, which accounts for 52% of our labour force and contributes 46% to the country's total GDP.[54] The type of activities women are engaged in makes them disproportionately more vulnerable to climate change: household water supplies, energy for cooking and for food security and high dependence on local natural resources for their livelihoods. Despite women undertaking 85% of Ghana's food distribution, they face gender constraints related to accessing land and formal financial services. The Ghana National Adaptation Plan (NAP)[55] states that '*women in Northern Ghana are particularly vulnerable to the adverse impacts of climate change, which could partly be attributed to extreme poverty and sociocultural factors including land tenure insecurity that can limit women's capacity to adequately respond to climate change'*. A vulnerability risk assessment carried out by USAID[56] indicates that besides women, migrants and (socially) unconnected landless farmers are also among the most vulnerable groups in Ghanaian society. These groups face challenges accessing land and securing livelihoods which reduces their adaptive capacity to climate change impacts.

The Ghana National Climate Change Policy discusses the importance of a gender responsive approach[57]: *'experience shows that interventions to strengthen livelihoods and food security from external shocks are more effective when gender differences are properly understood and addressed'*. Efforts to address gender constraints in relation to climate change must first address underlying gender inequities and recognise that women and men are affected differently by climate change impacts.

Youth are not as vulnerable to climate change as the other groups mentioned above as they are flexible: can easily move, migrate, change livelihoods which increases their adaptive capacity. However, they are often employed in vulnerable sectors such as agriculture, forestry and tourism and have limited access to land, assets and finance[58]. In addition, youth – forming a significant proportion of Ghana's population - will bear the impacts of climate change for much longer. This makes them important stakeholders in the climate change adaptation process. However, youth participation has been quite limited to date, contributing to low levels of awareness among this age group. The Ghana

[52] Webb et al. 2017. Land degradation and climate change: building climate resilience in. Frontiers in Ecology and the Environment, October 2017, Vol. 15, No. 8 pp. 450-459.

[53] Global Mechanism of the UNCCD, 2018. Country Profile of Ghana. Investing in Land Degradation Neutrality: Making the Case. An Overview of Indicators and Assessments.

[54] Ministry of Environment Science and Technology. 2012. Ghana National Climate Change Policy.

[55] Environmental Protection Agency (EPA). 2018. Ghana's National Adaptation Plan.

[56] USAID. 2011. Ghana Climate Change Vulnerability and Adaptation Assessment.

[57] Ministry of Environment Science and Technology. 2012. Ghana National Climate Change Policy.

[57] Environmental Protection Agency (EPA). 2018. Ghana's National Adaptation Plan.

[58] USAID. 2020. Ghana Country Development Cooperation Strategy (CDCS).

National Adaption Plan aims to provide more opportunities for youth to engage in the design and implementation of adaptation activities.

3.2.5 COVID and Climate

COVID-19 is seen as a threat multiplier for climate change, further exposing those already vulnerable groups as the poor are expected to be disproportionately affected[59]. It will be pivotal to ensure that the climate action momentum is not lost due to a diversion of attention. The World Bank COVID-19 Emergency Preparedness Response Project[60] describes the main approaches to address the further spread of COVID-19 to the closing of borders, schools, and churches, and physical distancing. Ghana is likely to (or is already) experiencing a tightening of credit, weaker growth, and reduced government revenues including funds for climate action. It is expected that there will be an increase in unemployment, food shortages, collapse of access to education or healthcare and extension services which could feed instability.

Ghana's government is using the National Adaption Plan (NAP) process to integrate both climate change and COVID-19 responses for food security; developing strategies to build resilience to the impacts from both climate change and COVID-19 in tandem. An already identified goals is to strengthen institutional collaboration across different ministries and sectors, because government responses to both climate change and COVID-19 demand cross-sectoral planning and coordination[61].

World Bank Group Supports Ghana's COVID-19 Response[62]: The World Bank has provided $100 million to Ghana to assist the country in tackling the COVID-19 pandemic as short, medium and long-term support.

3.2.6 Climate policy landscape:

Given that climate change poses myriad threats to Ghana as a result of projected increases in temperature and changes in rainfall patterns, the effort to mitigate and adapt to climate change is of paramount importance to all Ghanaians.

As a result, Ghana's commitment to Climate Action (SDG13) is outlined in the following key national and sector polices documents, which are aligned with the Long-term National Development Plan of Ghana (Vision of Growth 2018-2057), Ghana@100:

- National Climate Change Policy (2014)
- Ghana National Climate Change Master Plan Action Programmes for Implementation (2015-2020)
- National Climate Change Adaptation Strategy (2010-2020)
- Nationally Determined Contributions (2020-2030)
- Ghana Beyond Aid Charter and Strategy Document (2019)
- Strategic Medium-Term Plan for the Ministry of Works and Housing (2018-2021)
- Ghana Plan of Action for Disaster Risk Reduction and Climate Change Adaptation (2012)
- National Climate-smart Agriculture and Food Security Action Plan (2016-2020)
- Ghana Irrigation Development Policy (2011)
- Ghana's National Adaptation Plan Framework (NAP) (2018)

The Environmental Protection Agency (EPA) recently published Ghana's Fourth National Communication (NC4) to the United Nations Framework Convention on Climate Change (UNFCCC)[63]. This document outlines the latest information on Ghana's progress at addressing climate change through specific policies. Regarding climate adaptation, the following adaptation areas could be relevant to PROSPER:

[59] Idem.

[60] World Bank. 2020. World Bank Group Supports Ghana's COVID-19 Response.

[61] UN Environment. 2020. COVID-19 is a wake-up call': Ghana to develop national plan for climate adaptation.

[62] https://www.worldbank.org/en/news/press-release/2020/04/02/world-bank-group-supports-ghanas-covid-19-response.

[63] Environmental Protection Agency (EPA). 2020. Ghana's Fourth National Communication (NC4) to the United Nations Framework Convention on Climate Change (UNFCCC).

1. **Strengthening capacities of District Assemblies and EPA Regional Staff on mainstreaming climate change.** This includes training district assembly staff and mainstreaming climate change into district plans, programmes, and policies.
2. **Strengthening systematic observation, climate services, and early warning systems**: I) developing additional automatic weather stations, II) establishment of emergency operation centres for early warning and communication for priority hazards, (III) flood and drought hazard assessment in White Volta and Oti River basins.
3. **Building resilience in vulnerable agricultural landscapes**: I) resilience building of smallholder farmers and fragile ecosystems in the Northern dryland, (II) Investment in climate risk transfer (drought index insurance).
4. **Developing capacity and research for adaptation**: research on climate impacts and cocoa production, climate change and migration, climate change, and water resource management.

The EPA has also identified several barriers to climate change adaptation in Ghana:
- Limited institutional and technical capacity.
- Slow adaptation and mainstreaming into district development plans.
- Poor spatial distribution and population coverage of climate change adaptation projects.
- Low private sector participation.
- Limited adaptation funding.

An overview of Ghana's Climate Change Governance and the institutional involvement in the implementation of the UNFCCC in Ghana can be found in Appendix 2.

The main stakeholder for climate interventions in (Northern) Ghana have been mapped as part of this mission. An overview of the stakeholders, their interventions, partners, activities, target groups, and lessons have been included in Appendix 5.

3.3 Synthesis climate and nutrition linkages

Climate change and food and nutrition security are strongly interlinked in Ghana. The country is experiencing increased extreme weather conditions with higher incidences and more prolonged periods of flooding and droughts[64]. High temperatures will further increase, and rainfall patterns will be less predictable. These climate stresses are already affecting nutrition security through different causal pathways that impact food security, livelihoods, household food access, maternal and childcare, health, water and sanitation, and many socioeconomic factors that determine nutrition security[65].

The 2013 Lancet series on maternal and child nutrition[66] distinguish three major interactive pillars to be simultaneously achieved for attaining optimum foetal and child nutrition and development: 1) Food Security, 2) Feeding and caregiving and resources, 3) Access to and use of health services, and environmental health. These three pillars form the pathways through which climate change can exacerbate malnutrition[67]. Below a summary and synthesis of the climate impacts on the dimensions of food and nutrition security in Ghana, based on the findings of the climate and nutrition situation analysis.

Food security: Climate change is expected to affect all dimensions of food security, namely the physical availability of food, its economic and physical accessibility, its use, and the stability of these three dimensions over time: loss of productive lands (e.g. desertification), yield reductions (particularly for cassava and maize)[68], decreased livestock value, values, post-harvest losses, and reduced food accessibility and consumption. In addition, climate change is leading to water stress and the outbreak of pests and diseases for crops and livestock. Nutrient-rich foods that are currently in

[64] USAID. 2017. Climate Change Risk Profile Ghana.
[65] Ministry of Foreign Affairs of the Netherlands. 2018. Climate Change Profile Ghana.
[66] Black et al. 2013. Maternal and Child Undernutrition and Overweight in Low- and Middle-Income Countries. The Lancet (Maternal and Child Nutrition).
[67] Bakker et al. 2020. Food system interventions with climate and nutrition co-benefits. A literature review.
[68] Ministry of Foreign Affairs of the Netherlands. 2018. Climate Change Profile Ghana.

short supply in many low-income settings are particularly susceptible to water constraints, pests and diseases[69]. Other impacts are post-harvest losses due to difficulties in crop preservation as a result of heavy and erratic rainfall. Floods also cut off communities from markets, production areas and other services, further reducing their food accessibility.

Feeding, caregiving and resources: Women in Ghana face more constraints in allocating their time between productive and domestic activities. The most time-consuming activities for women are cooking and caring for household members. Yet, the type of activities women are engaged in makes them disproportionately more vulnerable to climate change: household water supplies, energy for cooking and for food security and high dependence on local natural resources for their livelihoods. In addition, increased temperatures greatly influence fungal growth and aflatoxin production in cereals and legumes, the major staples in Ghana, which are often used for complementary feeding. Consumption of contaminated ingredients could expose infants and young children to poor growth and development[70].

Environmental health and access to health services: Climate change will have direct and indirect impacts on human health and access to health services[71,72]:

- Drying threatens the quantity and quality of water available for irrigation (food production) and WASH practices, which are key to nutrition. The Northern, Upper East and Upper West regions, which suffer water scarcity, have lower than national average access to basic water. Diarrhoea is a major cause of malnutrition, and generates an indirect cost as children's caretakers are absent from work to stay in the hospital with their sick child. Studies show that Malaria, diarrhoea, and Cerebral Spinal Meningitis are being aggravated by impacts of climate change in Ghana. Incidence and distribution of these diseases might change due to changes in temperature, humidity and poor sanitation.
- Increases in frequency of cholera outbreaks have been reported during rainy seasons, as well as during dry periods as people resort to unsafe water sources during limited water supplies.
- Floods also hamper access to markets or nutrition and health services.

There is an overlap in vulnerable groups in relation to malnutrition and climate vulnerability:

- children of mothers with low educational levels
- children of young mothers
- mothers and children living in the Northern provinces of Ghana

Ghana National Climate Change Policy has outlined the following policy objectives in relation to health[73]:

- 'Identify and improve data recording, reporting, analysis and storage of climate-sensitive diseases at all levels of service delivery.
- Enhance knowledge and sensitise the health sector on the impacts of climate change including issues for vulnerable groups such as the aged, women and children.
- Minimise the impacts of climate change on health in communities whilst strengthening public health care delivery and preventive care'.

[69] Bakker et al. 2020. Food system interventions with climate and nutrition co-benefits. A literature review.

[70] M.A. Achaglinkame, N. Opoku, F.K. Amagloh. Aflatoxin contamination in cereals and legumes to reconsider usage as complementary food ingredients for Ghanaian infants: a review J. Nutr. Intermed. Metabolism, 10 (2017), pp. 1-7.

[71] Ministry of Health, UNDP, GEF. Climate Change Health Risk Mapping Sub-National Climate Risk Maps for Ghana.

[72] Ministry of Environment Science, Technology and Innovation. 2013. Ghana National Climate Change Policy.

[73] Environmental Protection Agency (EPA). 2018. Ghana's National Adaptation Plan.

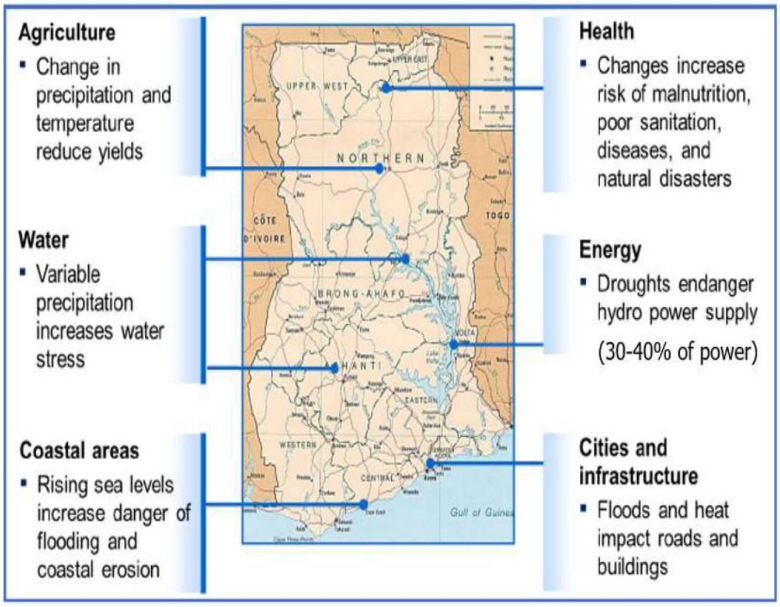

Figure 8 *Projected impact of climate change as summarised in the Coordinated Program for Economic and Social Development Policies (2017–2024).*

The National Nutrition Policy does not mention climate change, neither does the National Policy for the Prevention and Control of Chronic Non-Communicable Diseases in Ghana. The Coordinated Program for Economic and Social Development Policies (2017–2024) acknowledges the impact of climates development objectives and summarises the impacts in different ecological locations, as depicted in Figure 8.

4 Theory of change and pathways

The main issues for climate change, nutrition and their interlinkages, in the PROSPER targeted areas, as identified in the situation analysis are high levels of poverty, environmental degradation, high levels of malnutrition (especially anaemia), poor dietary diversity (of women and children), seasonal hunger, low access to affordable and nutritious foods, reduced livestock and crop productivity as a result of climate change, and seasonal variation in the availability of nutritious foods due to water stress and pest and diseases.

Overall, PROSPER's development objective is *to integrate sustainable NRM practices and climate-smart technologies in the crop value chains; improve crop productivity and quality; and stimulate agribusiness partnerships resulting in increased income, better nutrition and food security.*

To tackle the nutrition and climate-related issues described in the situation analysis, we recommend that the project sets specific climate and nutrition outcomes for PROSPERs contribution. Table 1 presents the proposed outcomes in the left column and the intermediate outcomes to be put in place in the right column.

Table 1 *Climate and Nutrition Outcomes and Intermediate Outcomes.*

Suggested climate/nutrition outcomes	Intermediate outcomes to be put in place (adapted to context of PROSPER)
Increased year round food security	Increased availability of nutritious foods, increased household income, improved storage practices, increased livestock and crop diversity at the farm
Improved dietary diversity	Increased access to nutritious foods, Improved nutrition awareness, Increase decision making power of women
Improved climate resilience of smallholder crop producers through improved crop farming practices	Increased livestock and crop diversity at the farm, Increased production (maize, rice, soy, shea, small ruminants, poultry, cashew) and increased adoption of climate-smart cropping practices adopted by SHF
Restored and resilient agro-ecological landscapes	Increased sustainable natural resources management (NRM) and climate-smart practices adopted by smallholder farmers

A detailed overview of how the interventions proposed in PROSPER will contribute to these climate and nutrition outcomes is presented in an adapted Theory of Change prepared by the team on Miro; https://miro.com/app/board/o9J_khE1xaI=/

5 Menu of key activities

Based on the situation analysis, identified pathways for PROSPER to nutrition and climate outcomes, and consultations with stakeholders, the mission recommends the following set of interventions to be included in PROSPER, to promote the mainstreaming of nutrition and climate in an integrated manner:

PROSPER Component 1.1 Develop climate-resilient, agricultural systems and assured marketing partnerships

1. Homestead garden: Women-led community gardens in dry season
2. Introducing Farmer-Managed Natural Regeneration (FMNR)
3. Strengthening extension services
4. Climate-smart agriculture at scale

PROSPER Component 1.2 Rural financial services

1. Revolving funds for Women groups accessing loans
2. Climate-smart business plans for reducing food loss and waste

PROSPER Component 2.1 Strengthen community institutions

1. Social behaviour change communication

PROSPER Component 2.2 Enabling infrastructure development

1. Promoting greenhouse farming for youth

The proposed interventions will contribute to the intermediate outcomes and longer-term outcomes listed in Table 1 of the previous chapter.

The following sections will describe each of the interventions including a description of the activities, climate and nutrition pathways, potential trade-offs, targeting, recommendations for implementation arrangements, potential partners, and unit costs (if possible).

5.1 Homestead garden: Women-led community gardens in dry season

Description of activity: Women (15–49 years) with young children (6–23 months of age), members of an existing community-based women's group, or a new group to be established, and people with disabilities. The women groups will be provided with wooden containers or materials for wooden containers (size depending on the crop to be produced: Hibiscus sabdariffa, okro, beans, tomatoes, chilli, cabbage, lettuce etc). Container gardening will be particularly suitable for people with disabilities as they do not need to leave the homestead. In communities where access to land is not a challenge, solar powered boreholes can be drilled to enable groups to cultivate their produce. Containers should be assembled in central locations in the respective communities and fenced as demonstrated in some earlier studies in Northern Ghana[74]. Depending on crop choice, it should be possible to harvest at least every four weeks, e.g. as is the case for Hibiscus sabdariffa. Women's groups will market their wares cooperatively, and will receive training on marketing. Money from sales will be saved in the group's bank account, and 20-50% of the income will then be used to buy animal source foods (such as dried fish) and iodised salt for household consumption. The groups will set ground rules on this before the commencement of production for sale. The activity should be linked to nutrition education. See also proposed intervention no. 7 on SBCC for nutrition. The community (containers) garden will be

[74] Kubuga, C. K., Dillon, A., & Song, W. (2018). Container gardening to combat micronutrients deficiencies in mothers and young children during dry/lean season in Northern Ghana. Journal of Hunger & Environmental Nutrition, 1-14.

combined with animal rearing at the household level or utilise the communal gardening model, depending on the community dynamics.

Climate and nutrition pathway(s): This intervention helps produce vegetables for consumption during the dry season, thereby addressing the high rates of food insecurity during lean season, poor access to micronutrient-rich foods, and limited irrigation lands and water in Northern Ghana. It is possible to harvest every four weeks. Previous studies with women-led community/container gardens in Northern Ghana have demonstrated that container gardens are capable of producing adequate amounts of Hibiscus sabdariffa leaves to meet mother and child dyad's consumption to improve iron status (upon consumption of Hibiscus sabdariffa leaf meals three times a week for 12 weeks) during the dry/lean season[75]. The container helps individuals adapt to the challenges that come from land and water scarcity. Containers can be mulched with straw to prevent water loss and keep a cool temperature within the containers. Pieces of wood on top of the straw prevent wind from carrying mulch away. The bottom of the containers can be sealed to prevent excessive water losses. Harvesting rainwater as well as recycling household wastewater could help to further mitigate the water-related challenges. In communities where boreholes can be drilled, community gardens can be created. By diversifying their livelihoods with container gardens and animal rearing, farmers become less dependent on (mono) crops. This will increase their adaptive capacity and make communities more resilient to climate-related hazards. By selecting crops and livestock varieties based on their nutritional value and climate resilience, this intervention can improve access to nutritious foods for household consumption and support food production in a changing climate.

Potential trade-offs: Setting up and maintaining the gardens requires a time investment of the target group. This could have implications on their workload and compromise the time left for childcare practices. Previous studies among Ghanaian households have shown that garden owners did not follow the recommendations for the safe use of chemical pesticides and this then has both environmental and health implications[76]. Animal rearing within the household has the negative trade-off that, if not well-managed, animal faeces from the livestock constitutes a significant risk factor for diarrhoea and environmental enteric disorder in young children, which may significantly contribute to undernutrition[77].

Targeting: women (15–49 years), pregnant or with young children (6–23 month of age) who belong to or are willing to join a community-based women's group and people with disability. This is also often the group of households with limited access to land, hence a container garden is better suited. Container gardening will particularly be suitable for people with disabilities as they do not need to leave the homestead or travel far from home for food production or acquisition.

Recommendations for implementation arrangements:

- The following crops and varieties are recommended based on their nutrient value and climate resilience; Roselle/Hibiscus Sabdariffa (can improve iron status[78]), okra, beans, pepper, tomatoes, cabbage, and cucumber). It will be important to include crops with less economic value, but high nutrition value, to reduce the risk that women will sell all the produce. For income generation it is recommended to grow chili, cabbage, lettuce, beetroot and tomatoes because of their ready market and high value. As for animal rearing, the following smaller animal species are recommended: poultry, guinea fowl, and rabbits (it is worth noting that preferred animals may vary by community).
- In addition to the above crops, it is recommended to use the catalogues on Indigenous Vegetables in Ghana[79], developed by WCDI in collaboration with UDS, to identify local nutrient-dense vegetables.
- Supporting transport for the women's group, e.g. by motorbike, can help them carry produced vegetables for sale and sustain the container garden.

[75] Idem.

[76] Akrofi, S. (2012) Home garden: a potential strategy for food and nutrition security in HIV households. A case study in rural Ghana. PhD thesis, Wageningen University, Wageningen, The Netherlands, 239 pp.

[77] Headey, D., Nguyen, P., Kim, S., Rawat, R., Ruel, M., & Menon, P. (2017). Is Exposure to Animal Feces Harmful to Child Nutrition and Health Outcomes? A Multicountry Observational Analysis. The American journal of tropical medicine and hygiene, 96(4), 961–969. https://doi.org/10.4269/ajtmh.16-0270.

[78] Kubuga, C. K., Hong, H. G., & Song, W. O. (2019). Hibiscus sabdariffa Meal Improves Iron Status of Childbearing Age Women and Prevents Stunting in Their Toddlers in Northern Ghana. Nutrients, 11(1), 198.

[79] Currently under final review. Once finalised, the catalogue will be available on https://www.hortifresh.org/

- To link this intervention with proposed intervention 6, on youth managing cold room storage facilities. Young men and women can also be engaged in the container garden activities.

Potential Partnerships: For this activity, it is recommended to work with the University for Development Studies (UDS) to provide training on community container gardens. Researchers from the Nutritional Science Department of UDS have already implemented interventions on container gardens in Paga (upper East region). In addition, MoFA could help with extension services for the container gardens.

Costs:
Container ($16.46/container, with life span of 4 years)

Solar powered Irrigation system unit/borehole =$7500 – $12,500.

Additional cost components: Training of extension workers, training of beneficiaries, Extension service provision on continuous basis, inputs for container/garden, fencing, borehole drilling.

5.2 Introducing Farmer-Managed Natural Regeneration (FMNR)

Description of activity: Farmer-Managed Natural Regeneration (FMNR) is a low-cost and easy restoration technique suitable for smallholder farmers (SHF) to increase crop revenues, reduce climate vulnerability and counter land degradation[80]. In these systems, trees that occur naturally in their fields are grown together with crops. Farmers select and protect the most vigorous stems and manage threats to remaining branches from livestock, fire and competing vegetation. Through pruning, the regeneration of trees increases, thereby resulting in enhanced crop productivity and on-farm forest products. Dominant tree species found on-farm in Northern Ghana are: shea, cashew, ebony, dawadawa, moringa, neem and tamarind. These indigenous trees are naturally adapted to the local conditions and are therefore less vulnerable to environmental and climate stresses than introduced species. Maize is the favourite crop among farmers, often intercropped with beans, groundnuts, millet or sorghum. The activity could greatly benefit from complementary CSA practices e.g. crop rotation, mulching, composting, use of new and improved seeds varieties. See also intervention no. 4 on CSA practices.

Communities and farmer-based organisations gain 1) FMNR training (pruning, thinning, wildfire management, relevant CSA practices), 2) inputs (equipment, seeds etc.) and 3) access to longer-term finance (see recommendations for implementation). Additional activities for upscaling consists of 4) piloting FMNR activities on degraded communal land. These serve as learning sites and can attract interested farmers in the region.

Climate and nutrition pathway(s): FMNR contributes to food and nutrition security benefits and climate change adaptation and mitigation efforts.

- **Increased food and nutrition security of farmers:** The regreening Africa project has shown that FMNR communities are considerably more food secure. 1) Crop productivity is enhanced, moreover intercropping e.g. with protein rich crops can result in increased dietary diversity and quality[81]. 2) Enhanced harvests of a wide range of on-farm and nutritious forest products (fruits, nuts e.g. cashew and pods) during the dry season when they otherwise would face food shortages. New product lines can be developed from the shea fruit (the pulp) to make the fruit available and accessible during off season. This could curtail large losses and underutilisation of the shea fruits.
- **Increased productivity & income:** Through replacing slash and burn practices by combined FMNR and crop rotation practices, farmers can increase their productivity. Evidence shows that in Northern

[80] Westerberg et al. 2019. Reversing Land Degradation in Drylands: The Case for Farmer Managed Natural Regeneration (FMNR) in the Upper West Region of Ghana. Report for the Economics of Land Degradation Initiative.

[81] Nyemeck Binam, Joachim. (2015). Effects of farmer managed natural regeneration on livelihoods in semi-arid West Africa. Environmental Economics and Policy Studies. 17. on line first. 10.1007/s10018-015-0107-4.

Ghana farmers have increased the productivity of their cropland by an estimated 83% within five years. An additional 4 Ghana Cedis (GHS) can be earned from enhanced forest and crop produce for every Ghana cedi invested. However, the first years require investment and farmers will not observe an immediate income increase. However, after 3-4 years, they will earn above and beyond what they would have earned by implementing FMNR practices (Figure 9).

- **Increased landscape resilience:** FMNR combined with CSA practices contributes to regreening of degraded agricultural landscapes and reduced frequency of bushfires. As tree density increases, so does the soil quality and crop yields. Growing trees also reduces pressure on off-farm natural resources as farmers can collect their fuelwood on-farm and reduce their slash & burn practices. Fire prevention costs are also expected to go down. These environmental benefits will reduce the climate vulnerability of these landscapes and their inhabitants. Especially the northern regions of Ghana which are highly exposed to climate-related weather extremes such as floods, droughts, bushfires and storms.
- **Increased climate resilience of farmers**. FMNR communities have higher levels of adaptive capacity. Through increased food and nutrition security, more diversified livelihood income and living in more resilient landscapes, farmers gain improved access to income and food year round, making them less vulnerable to climate-related stressors.

Potential trade-offs: FMNR could have a trade-off in farm productivity and economics if farmers wish to increase their production using tractor ploughing. In such a case, different approaches are needed, such as leaving trees only when they are standing in lines or only on field boundaries. Tree theft has been reported to be a major discouragement to the adoption of FMNR in some contexts, so the risk could be an increased level of conflict within communities.

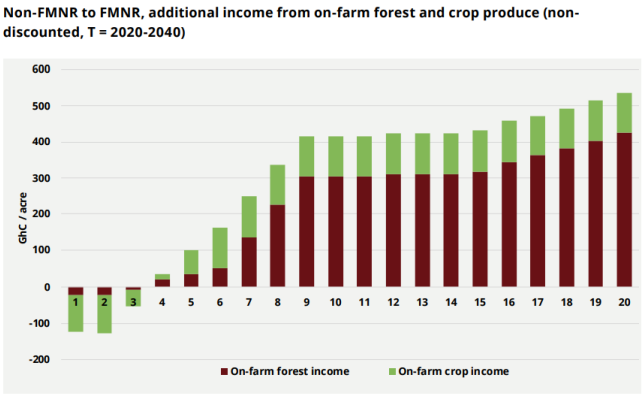

Figure 9 *Non FMRN to FMNR, additional income from on-farm forest and crop produce*[82]*.*

Targeting: Smallholder farmers living in degraded agricultural landscapes (northern regions) and where farmers have limited access to tractor services because of high costs and small farm sizes. Women (15–49 years) are often already engaged in the collection and harvesting of Non-Timber Forest Products (NTFP). Regarding Shea, it is mainly women who collect and process the kerns into shea butter. Local leaders, who, through leadership skills training, can inform communities on the benefits of FMNR.

Recommendations for implementation:

- Providing long-term finance: Most farmers have access to rural loans, but with high interest rates and relatively short-term repayment schemes. As income derived from FMNR activities increases only after 3-4 years, these existing loans do not allow for repayment from the sale of forest produce. These funding gaps of longer-term credit could be covered by Igreenfin loans (GCF) as they are aligned to the programme's objectives to '*support the building and scaling up of the*

[82] Westerberg et al. 2019. Reversing Land Degradation in Drylands: The Case for Farmer Managed Natural Regeneration (FMNR) in the Upper West Region of Ghana. Report for the Economics of Land Degradation Initiative.

resilience and adaptive capacity of rural communities and farmers' organisations by allowing beneficiaries to access credit lines for green agricultural investments'.

- Improving women's access to information by training more women extension staff, holding separate meetings for women farmers, and ensuring that women are fully represented in all activities.
- Encourage intercropping with legumes for higher agricultural productivity and increase availability of protein, fibre and micronutrient (folate, B vitamin) rich foods for nutrition.
- Provide access to equipment. A study in Ghana showed that the most important determinant for SHF is access to equipment.
- Involvement of local leaders or 'FMNR champions' for information sharing of practices and setting the rules for wildfire management.[83]

Potential partners: It is recommended to collaborate with the *Regreening Africa* (2017 – 2022) project which works on scaling up appropriate ways of integrating trees into agricultural systems to successfully reverse land degradation across Africa. They are active in Northern Ghana (partners include: ICRAF Sahel, World Vision Ghana, Catholic Relief Services, ICRAF Sahel). The Ministry of Environment, Science, Technology and Innovation (MESTI) is currently also implementing a land & water management project. Other partners working on FMNR in Ghana are: the Center for Indigenous Knowledge and Organisational Development (CIKOD), World Vision, University of Development Studies (UDS), Council for Scientific and Industrial Research (CSIR), Environmental Protection Agency (EPA), GIZ Ghana and MoFA.

Costs: FMNR projects require higher initial investment, but after 3-5 years, costs per hectare continues declining, while income increases. See an example of unit costs of a project implemented in Northern Ghana in Table 2. This table compares the costs of conventional farming versus FMNR combined with sustainable land management (SLM) practices. The costs are cited in Ghana Cedies GhS/Acre.

Table 2 *Costs FNMR[84].*

Conventional farming / Non-FMNR	
Benefits, crop production	
	GhC/acre
Crop Revenue	**290**
Costs	
Variable	
Tractor services (year 1-30)	60
Seeds (year 1-30)	7
Fertilizer (year 1-30)	60
Pesticides (year 1-30)	2
Total hired labour (year 1-30)	45
Pruning (year 1-3)	
Thinning (year 4-30)	
Fixed	
Training of fire volunteers	
Training of lead farmers	
Equipment fire volunteers	
Equipment lead farmers	

FMNR & SLM scenario			
Benefits, crop production			
	GhC/acre		
Crop revenue, at outset	**290**		
Crop revenue, after 5 years	**540**		
Annual increase in crop revenue (year 0-4)	50		
Costs			
Variable			
Tractor services (year 1-30)	125		
Seeds (year 1-30)	22		
Fertilizer (year 1-30)	60		
Pesticides (year 1-30)	2		
Total hired labour (year 1-30)	90		
Pruning (year 1-3)	40		
Thinning (year 4-30)	20		
			Note
Fixed, CIKOD	**Per acre**	**Per household**	
Training of fire volunteers	16	32	Costs borne by CIKOD
Training of lead farmers	16	32	
Equipment fire volunteers	7,6	15,2	
Equipment lead farmers	20,5	41	
Fixed, farmers	40	80	

[83] UN SDG Platform. Farmer Managed Natural Regeneration (FMNR): a technique to effectively combat poverty and hunger through land and vegetation restoration 2020.

[84] Westerberg et al. Reversing Land Degradation in Drylands: The Case for Farmer Managed Natural Regeneration (FMNR) in the Upper West Region of Ghana. Report for the Economics of Land Degradation Initiative. 2019.

5.3 Strengthening Extension Services

Agricultural extension also known as agricultural advisory services plays a crucial role in boosting (climate-smart) agricultural productivity, increasing food security, improving rural livelihoods, and promoting agriculture as an engine of pro-poor economic growth. In Ghana, MoFA is the primary provider of agricultural extension services, though not the sole provider. Agriculture extension services in Ghana has gone through transformational changes over the years from the Training and Visit System (TVS) to the concept of Transfer of Knowledge by Agriculture Extension officers (AEOs), to reaching farmers with information. Despite these transformational changes, extensions services still have insufficient capacities in relation to climate technologies and climate communication.

Description of Activity: The MOFA staff needs to be strengthened in climate knowledge, latest technologies and sharing climate information to value chain actors. In an interview, the Deputy Director of MOFA in charge of Climate change and Crops indicated that there is a technical pool of expertise present within the department, but this requires trickling down to lower levels of governance and continual capacitation since climate-related technologies are changing every day. He indicated that there is an urgent need to train and retrain more agricultural extension officers. Moreover, the interviews with key stakeholders confirmed the important role that extension services play for the adoption of climate-smart and nutrition-sensitive agricultural practices. There is an opportunity here to train frontline extension officers/workers not only on climate-smart value chains and technologies, but combine it with nutrition-sensitive value chains.

This can be done by adopting innovative training approaches such as a mobile training unit and farmer voice radio. These allow for large groups of smallholder farmers (women and men) to receive audio and visual training lessons in rural areas. Strengthening nutrition and climate capacity of extension services will facilitate the implementation of other climate-nutrition interventions. The specific capacities that agriculture extension officers need to effectively integrate nutrition into their services include: climate-smart & nutrition-sensitive technologies for various value chain segments, technical knowledge of human nutrition, climate impacts on food and nutrition security, gender-sensitive nutrition awareness, communication, facilitation, and management skills.

Climate and nutrition pathway(s): Extension provides a critical support service for rural producers and other value chain actors meeting challenges confronting the agricultural sector: climate change impacts on agriculture and food and nutrition security, constraints imposed by COVID-19 and other health challenges that affect rural livelihoods, as well as the deterioration of the natural resource base. With large rural populations in Ghana, it can be difficult to reach farmers for training and travelling to training can be costly and time consuming for farmers. In addition, COVID-19 measures might also restrict travel and training provision.

Potential trade-offs: The potential trade-off of expanding the working package of extension workers, is that this may compromise activities which they are already being implementing. Also, if extension workers are expected to share a large amount of information to farmers, key messages for climate-smart and nutrition-sensitive farming may get diluted. Using different and innovative ways to reach farmers, e.g. through radio, may not result in the behavioural changes that are needed for improved nutrition, climate change adaptation and mitigation. Interpersonal communication is still one of the most effective strategies for behavioural change.

Targeting: Agricultural extension officers (male and female), youth and women farmer groups and smallholder farmers. Private sector service providers: One of the significant reforms that has been undertaken is to strengthen the private sector funding and delivery of extension services. In this strategy, various companies operating commercial or profitable production agricultural enterprises are to help in the delivery of extension services. For example, in sub sectors like cash crops (oil palm, rubber, cotton, pineapple and vegetables), extension services are expected to be financed and executed through processing companies under contract with farmers[85]). Agrochemical companies and

[85] Narayanan, S. 2014. Profits from participation in high value agriculture: Evidence of heterogeneous benefits in contract farming schemes in Southern India. Food Policy.

dealers are also expected to provide extension services to farmers on their products through training and field demonstrations.

Recommendations for implementation: For an enhanced innovative extension approaches, and to make room for unforeseen events like COVID-19, the following actions are recommended.

- Training frontline extension officers/workers on climate-smart and nutrition-sensitive value chains and technologies to allow them to efficiently reach out to farmers.
- Collaborate with ESOKO (weather information app) to provide digital information and/or training services to farmers.
- Collaborate with Farm Radio International – Radio innovation and radio resources to farmers.
- Civil society organisations working in the communities could be part of extension training activities to provide post extension services delivery to the smallholder farmers.
- Recruit and train female extension officers to target women in the communities who otherwise would be excluded from extension services.
- Development of toolkits for mainstreaming climate change and nutrition and gender-related issues at the community level and in preferred languages.
- Identify community institutions and platforms with similar activities to align PROSPER objectives.
- Collaborate with the ongoing GCF-funded National Adaptation Programme that is already planning the introduction of district adaptation plans to incorporate specific early warning systems into the district adaptation plans. This will also be important for agricultural extension services.

Institutional context - Lessons learned:

- **Individual empowerment**: When women are empowered with knowledge and skills, they can make a large impact in their community, and in other communities too.
- **Community-based:** The Women Extension Volunteers approach to knowledge transfer is a more sustainable solution that relies on the active participation of communities.
- **Partnerships:** International NGOs, as in the case of World Vision, play an important role in the continuity of Extension Advisory Services and can be a valuable partner for governments.
- **Formal education:** Including nutrition education and its role in EAS into college curricula is important, but more work is needed to ensure that the content is rigorous and that capacity and support are promoted.
- **Resource support**: Extension agents and nutrition specialists need basic financial support to engage with communities. This includes transport, SIM cards, and the ability to produce communication materials.

Potential partners

1. Catholic Relief Services,
2. AG Care (health, education and livelihoods)
3. MoFA Women in agriculture development
4. District offices of the Environmental Protection Agency for climate information and data
5. Climate Change Agriculture and Food Security Platform
6. GCF National Adaptation Plan
7. The Adaptation Fund project, Adaptation Fund
8. ACDEP (Contact: Mr. Joseph Nchor, Email:nchorjoseph@yahoo.com, Tel:0244068340)
9. Nutritional Sciences Department - University for Development Studies (Dr. C.K. Kubuga, ckubuga@uds.edu.gh, Tel: 0249177010)

5.4 Climate-Smart Agriculture at scale

Description of activity: The approach of Climate-Smart Agriculture (CSA) supports the transformation of food systems in order to adapt to climate change impacts with reduced emission of GHGs. Besides building more resilient agro-ecological landscapes, CSA practices also contribute to food and nutrition security goals. While a diverse range of CSA practices and technologies are practiced at farm level in Ghana, this is not happening at scale. Recommended methods for upscaling are 1) take context specific factors into consideration (agro-ecological conditions, SHF priority crops and practices, cultural differences, gender dynamics); 2) Tap into innovative financing mechanisms

that combine climate and agricultural finance from public and private sectors; 3) Align with Ghana CSA policy and scale up existing CSA platforms at the subnational level; 4) Promote upscaling of CSA practices along the value chain, instead of focusing on production only.

In the section 'Recommendations for implementation' specific recommendations are provided for two relevant agro-ecological zones for Prosper: Guinea savanna and Forest transition zone. Appendix 2 shows an overview of CSA practices in each agricultural value chain segment of these two agro-ecological zones.

Climate and nutrition pathway(s):

- **CSA can increase availability and access to nutritious food:** If farms fail to adjust to changing climate patterns, the quantity, quality, and diversity of foods will be reduced in both households and markets, particularly for women and children under age five. Therefore, adopting combined CSA practices such as planting stress-tolerant crops with improving water management, will reduce rural communities' climate vulnerability and increase food availability and accessibility.
- **CSA technologies can boost agriculture income for nutrition, health, and education:** When adopting new technologies, farmers face real costs related to changing climate patterns, such as crop and food losses that affect nutrition and health. But CSA activities can facilitate investments in better post-harvest processing and storage technologies. These technologies mitigate health risks from spoiled or contaminated food, protect households from food shortages and minimise food spending.
- **CSA can support the production and consumption of traditional food commodities**: As the climate changes, nutritious foods typically gathered from forests or grown in communities may no longer be available, forcing rural families to purchase potentially less nutritious foods instead. Both CSA and FMNR (see proposed intervention 2) can contribute to the production and gathering of traditional food commodities.
- **Increased climate resilience of farmers and other value chain actors:** through combining various CSA practices, actors along the entire value chain increase their adaptive capacity to climate-related stressors. Actors might be able to increase their crop and livestock revenues or increase marketing and selling through storage technologies.

Potential trade-offs: The trade-off of investing in CSA practices for common crops (e.g. maize, groundnuts, sorghum and cowpeas), is that an increased focus on these crops, which takes the focus away from other, sometimes more nutritious, crops. Crops which are less common, and have perhaps a lower market value, but which are important to nutrition security of local communities may also require investments to enhance CSA practices. Sheep, goats and pigs could be suitable for crop-livestock systems, yet these species are not likely to make it into the beneficiaries' diets. Bigger livestock allows savings, enables resources-poor households to amass assets, and helps fund planned and unplanned spending (e.g. school fees and illness). Due to these various and often critical uses, direct consumption of home-reared animal source food is not a major priority, especially for poor households. CSA practices can help to adapt to climate change, but can be time consuming. Especially intercropping, mulching, mixed farming and compost application have been reported by women to be cumbersome, and this may conflict with other responsibilities.

Targeting: Rural communities involved in a range of value chain activities: production, processing, marketing and service provision. District level actors also need to be targeted (e.g. male and female extension officers). Capacities need to be strengthened on preparing bankable proposals to access climate finance and to train communities in CSA practices[86] that also positively impact on nutrition outcomes.

Recommendations for implementation: General recommendations are given, but also context-specific recommendations are provided for the 2 most relevant agro-ecological zones for Prosper: Guinea Savanna and the Forest transition zone. These coincide with the project area for the calibration phase and the replication phase scenario.

[86] FAO and MoFA. 2018. Investment Framework for Mobilization of Resources into Climate Smart Agriculture (CSA) in Ghana.

General

- The adoption of integrated systems – combined CSA practices – are recommended and is already common in most zones.[87] The strength lies in crop and livestock diversification. Both for nutrition purposes (increased dietary diversity is associated with higher quality diets and micronutrient adequacy) and for climate resilience (varieties and seeds which are resistant to drought, pests & diseases)[88].
- Focus on the most common commodities. For food crops, maize is the most common and seen as a candidate crop for upscaling CSA practices in Ghana, particularly with trees on farms. For livestock the most common is local fowl.
- Gender was found to be crucial in the production systems. Women occupied niche positions in the processing and market segments of the value chain. Specific female activities are described in the next section.

Recommendations for Guinea Savanna agro-ecological Zone

Based on a CSA study carried out by FAO and MoFA carried out in a district in the Guinea Savanna, the following recommendations are given.

- **Take gender and youth considerations in CSA practices into account for effective targeting:** '*Men in general dominated in the utilisation of minimum tillage, mixed farming, bundling, stone lining, irrigation, bush fire controlling, compost application, Integrated Nutrient Management (fertiliser, manure), Pests and disease control, improved seed and Soil and Water management. Women in general dominated in the utilisation of mulching, cover cropping, intercropping or mixed cropping, access to weather information and extension education, livestock tethering and supplementary feeding*[89].' Appendix 4 outlines more details of the attributed gender and age (adult vs youth) utilisation and associated gender constraints for each CSA activity.
- **Invest in the value chain segment 'production' for maize, groundnuts, sorghum and cowpea 'through the promotion of CSA services provision segment** (extension education, production input, adequately equipped district mechanisation centre, technology, etc.)' This was prioritised in order to increase yields. Regarding groundnut, sorghum and cowpea, investment in processing was mentioned which is required for the establishment of factories to add value to these commodities. This can contribute to higher income levels and job creation for youth and women (see gender table in Appendix 4).
- **Invest in the following value chain segment for livestock:** For local fowl, goats and sheep, investment in the production segment of existing crop-livestock systems was prioritised. In addition, investment in the provision of vaccines and other medications to reduce livestock mortality was also mentioned. Lastly, establishment of livestock and poultry processing facilities for value addition was highlighted (see Appendix 4).
- **Carefully select CSA practices according to value chain segment and commodity**: see Appendix 4 for an overview by segment.

Recommendations for Forest Transition agro-ecological Zone

Based on a CSA study carried out by FAO and MoFA carried out in a district in the Forest transition zone Savanna, the following recommendations are given.

- **Take gender and youth considerations in CSA practices into account for effective targeting.** Women are mainly involved in processing (85%) and marketing (85%), whereas men are involved in production (52%) and service provision (70%). For the following CSA practices, more women than men were involved: Cover cropping (75%), intercropping (75%), mixed cropping (75%), supplementary feeding of livestock/poultry (60%), solar drying (65%), oven Smoking of meat/Use of LP gas (70%) and use of airtight bags to store gari (90%). Mulching, the use of Integrated Nutrient Management (fertiliser, manure), Weather information, and Soil and Water management were distributed equally among men and women. Young men are relatively more involved in service provision compared to young women, adult men and adult women. See also table for CSA utilisation by gender and age group in Appendix 4[90].

[87] Idem.

[88] Bakker et al. 2020. Food system interventions with climate and nutrition co-benefits. A literature review.

[89] FAO and MoFA. 2018. Investment Framework for Mobilization of Resources into Climate Smart Agriculture (CSA) in Ghana.

[90] Idem.

- **Invest in the processing segment for crops:** This zone is facing losses of tree cover and this shift in vegetation cover is reducing cocoa farming and timber logging. Most farmers engage in maize as their first crop (major crop and many uses), followed by cassava, tomatoes (vulnerable to weather extremes), and groundnut. Investment in these commodities will address income security as well as food security. The study reveals a great potential to shift from mainly production activities towards value additions activities of these commodities.
- **Integrating livestock into the farming systems:** This zone is facing tree cover loss and this shift in vegetation cover is reducing cocoa farming and timber logging. However, this opening op of forest land creates opportunities for integrating livestock into farming systems. In addition, more CSA practices can be applied to livestock/poultry value chains as the current focus is mainly on CSA within crop value chains in this district. Most farmers keep local fowl (income, consumption, use for cultural purposes, free range), followed by sheep, then goats and then pigs.
- **Carefully select CSA practices according to value chain segment and commodity**: see Appendix 4 for an overview.

Potential partners: Engage with the national Ghana Climate Change Agriculture and Food Security (CCAFS) platform and upscale the 11 existing subnational CCSAFS platforms. These are multi-stakeholder platforms who adopt an integrated approach and promote CSA practices at the district level. Stakeholders consist of the private sector, government, CSOs, district authorities, traditional authorities (chiefs), Ghana police service, fire service and health service). CCAFS developed these platforms together with MoFA, but were not able to continue upscaling due to lack of funds. Key informants associated with CCAFS recommended IFAD to engage with them early in the Prosper design phase and not in the validation phase only.

The government of Ghana is currently in the process of establishing a *Ghana Green Fund* which mimics the GCF (localised green fund). This could provide additional financial sources for IFAD.

There is also a gender coordination mechanism for climate change and gender mainstreaming which is facilitated by the Department of Gender of the Ministry of Gender, Children & Social Protection and funded by GIZ through UNDP.

Important policy documents included: 1) National Climate-Smart Agriculture and Food Security Action Plan of Ghana (2016-2020), developed by CGIAR and CCAFs; 2) Investment Framework for Mobilization of Resources into Climate-Smart Agriculture (CSA) In Ghana, developed by FAO and MoFA (2018).

Costs: CSA consists of a broad range of practices. An example is provided below from the coastal savannah in Ghana of the estimated implementation, maintenance and operation costs in USD.

Table 3 *Example of estimated costs[91].*

TABLE 6. ESTIMATED IMPLEMENTATION, MAINTENANCE AND OPERATION COSTS			
CSA practice	Implementation cost (US$ ha^{-1})	Maintenance cost (US$ ha^{-1})	Operation cost (US$ ha^{-1})
Crop rotation	220	200	489
Mixed cropping	717	71.5	97
Minimum tillage	691	70	387
Improved genetic resources	689	63	0
Improved nutrient management	63	31	0
Livestock prophylactic practices	278	23	560
Supplementary feeding	157	16	900
Improved livestock housing	1,840	404	533

5.5 Revolving funds for Women groups accessing loans

Description: Financial institutions and modern financial services such as digital financial services continue to increase access to financial service in general but widen the *access gap* to the rural poor. Offering such services to the rural poor is costly and a great number of rural poor and farming households remain unbanked[3]. Interestingly, the poor make complex financial decisions and use the limited range of financial instruments available to them to address their varying needs. The available formal and informal tools are often risky and expensive or lack necessary flexibilities[92,93]. To narrow the access gap, savings-led microfinance programs such as the Village Savings and Loan Associations (VSLAs) operate in poor rural communities in Ghana to help individuals save as a group and then lend out the accumulated savings to each other. The contributed fund is often limited and does not meet the loan demands of group members. We propose that a revolving grant be added to the women groups' contributed fund to enable many women to get access to credit facilities. Interest rates for borrowing from a group's fund and the period for repayment are collectively decided by group members.

Climate and nutrition pathway(s): This intervention helps to provide women with alternative income which will prevent households from sacrificing food stuff meant for consumption to meet competing needs. It would also enable households to purchase climate-smart inputs (improved seeds) to improve production yields. Additionally, it would contribute to improving the purchasing power of households to enable them to afford other nutritious foods that are not produced by households. An earlier research indicated evidence of an improved resilience among women in savings and loans groups: in villages affected by drought, households experienced improved food security and income[3].

Targeting: Women and men (15–49 years) who belong to or are willing to join a community-based women's/men's group, and youth groups. Quantum of grant is often a function of the average amount borrowed per person and group's loan demand.

[91] USAID, 2017. Cost And Benefit Analysis For CSA Practices In The Coastal Savannah Aez Of Ghana.

[92] Karlan, D., Savonitto, B., Thuysbaert, B., & Udry, C. (2017). Impact of savings groups on the lives of the poor. Proceedings of the National Academy of Sciences, 114(12), 3079-3084.

[93] Collins D, Morduch J, Rutherford S, Ruthven O (2009) Portfolios of the Poor: How the World's Poor Live on $2 a Day (Princeton Univ Press, Princeton).

Recommendations for implementation:

- Women and men groups should be dealt with separately. Men's groups require regular monitoring as loan repayment defaulting could be high as reported in other studies.
- It will be important to put in deliberate food consumption measures for groups - to ensure that a fraction of the interest accrued from loans (20%-50%) will be channelled to household micronutrient rich foods consumption as reported by Kubuga et al in their container garden project.
- The food consumption measure becomes the condition for a group's reception of a revolving grant.
- Foods should be bought in bulk and shared with each member (groups will decide how to support members with large families).
- Food to be purchased should be predefined: high quality but low cost micronutrient rich foods (e.g. Anchovies, iodised salt, dawadawa, grains etc) as interest rates are low (9% - 15%) but enough to purchase such foods.

Potential Partnerships: For this activity, it is recommended to work with ACDEP as they have worked with smallholder farmers across Northern Ghana. In addition, World Vision could help with training as the VSLA model originated from them. Besides, World Vision is operating within the intervention areas. Another potential partner could be the University for Development Studies (UDS). Researchers from the Nutritional Sciences Department of UDS are currently piloting the revolving fund interventions in Sakaa – Paga and Buru - Paga (upper East region).

Cost: Quantum of grant per group is often a function of the group's annual contribution, average amount borrowed per person, and credit demand. Cost per group (usually an average membership of 25) may range from $1,000 to $5,000 in rural communities. You may have more than 3 groups in each village/community.

5.6 Social Behaviour Change Communication

Description of activity: The pre-design mission team recommends to go beyond nutrition education and awareness-raising campaigns, and instead to develop a Social Behaviour Change Communication (SBCC) strategy to promote consumption of diversified diets and improved WASH practices. SBCC is a combination of communication approaches, activities, and tools used to positively influence behaviours. In addition to improving knowledge at the individual or household level, it includes action directed towards positively changing social attitudes and mobilising communities to adopt and maintain nutrition-sensitive and specific behaviour or practices. The following channels can be used for SBCC activities: (digital) extension services, social media, mass media (radio and television), (interpersonal communication) through health facilities and community outreach, household visits, mother-to-mother support groups, and Livelihood Empowerment Against Poverty (LEAP) administration events. The community institutions that will be supported by PROSPER (farmer's based organisations, cooperatives, women/youth savings and enterprise groups) form another channel for SBCC activities. The latter could include (food) fairs, contests, and dialogues as well as community radio and video production and dissemination events. The SBCC activities, however, can also be used to address behaviours that could negatively affect climate change, such as slash and burn practices, or the consumption of high amounts of red meat.

Climate and nutrition pathway(s): People's nutrition status and diet choices affect their capacity to adapt to climate change. A well-nourished, healthy population is more resilient to seasonal shocks, the consequences of extreme weather events, e.g. injuries, and better protected against disease[94] and heat stress. Adolescent girls are potential conduits of intergenerational nutritional status. Well-nourished girls will be in a better position to withstand seasonal shocks when they eventually become pregnant, so a life-course approach to interventions is vital.

[94] Either zoonotic disease outbreaks or human parasitic, viral, and bacterial diseases for which transmission dynamics and distribution patterns are expected to change due to climate change.

Relevant stakeholders/target groups and how to reach them: Given the need to influence the enabling environment, the following audience targets should be distinguished: mothers, fathers, adolescent and young boys and girls, grandparents, farmers, GHS staff.

Recommendations for implementation:

- To prioritise a small set of behaviours, as evidence confirms that SBCC interventions are most effective when they promote a limited number of 'doable' actions at one time. Considering the behaviour already covered by other development partners and the relation to other activities implemented under PROSPER, SBCC activities could focus on improving dietary diversity, home consumption of nutritious produce, and increasing intake of iron-rich foods.
- The nutrition SBCC activities currently implemented by WFP and GHS service in Northern Ghana focus on PLW and children under two. IFAD could complement these by organising specific activities targeting adolescent boys and girls.
- To use formative research to analyse social norms and taboos, and barriers towards key behaviours, and design interventions around these, instead of simply promoting (by providing information on) the importance of nutrition behaviours. Especially the beliefs and norms which prevent households from keeping nutritious produce and livestock for home consumption should be well understood (see also situation analysis).
- Materials for SBCC have already been developed and are being used in the target districts (e.g. by WFP, GHS and AIDEZ). These include specific messages for audience segments. It will be important to stick to that so as not to distort the information received by the target beneficiaries already.
- To ensure that SBCC materials used for activities are in line with the Ghana Food based dietary guidelines, which are currently prepared by MoFA and the University of Ghana[95].
- Current SBCC activities for nutrition focus generally on topics related to nutrition for Pregnant, and lactating women and on Infant and Young Child Feeding. IFAD can complement this with a focus on dietary diversity (for all) including nutritious iron-rich foods and adolescent nutrition.
- Topics to be covered could include: Use of indigenous crops for nutrition security, Breast feeding, Complementary feeding, home consumption of produce, WASH, Gender and nutrition (early marriage, sexual and reproductive health), good practices to prevent harmful effects to climate change and the, soon to be published Food based dietary guidelines.

Potential Partnerships: The Ghana Health Service would be the preferred partner for SBCC activities since the government health channels are trusted sources of health and nutrition messages to community members (according to WFP and Key Informants) and to ensure sustainability. The GHS has also adopted a combined approach, including following SBCC activities in Northern Ghana: capacity building of community health workers, distribution of Information Education Communication (IEC) materials, cooking demonstrations (providing locally available food in partnership with MoFA), and role plays in local languages that include community members. IFAD could complement these activities to increase the outreach (including more audience segments), and address the lack of materials for SBCC activities, which currently hampers GHS SBCC implementation. One recommendation is to align with the SBSS activities which WFP, AIDEZ Small Project International, Private sector, Farm Radio International, Local Food-based Approach to Improved Nutrition (LoFAIN) Gov of Japan, LEAP, and GHS are already doing in Northern Ghana. MoFA will be another important partner for these interventions.

5.7 Promoting greenhouse farming for Youth

Description of activity: Greenhouse farming is becoming increasingly popular in Ghana, being especially attractive among youth. Promoting investment in greenhouse vegetable farming that targets youth can contribute to Prosper's objectives. This will require initial investments and loans for youth groups, but could offer crop protection against various weather conditions and pests. Combined with good management, this will result in improved production (year round), product quality, resource efficiency and job opportunities for youth. Suitable for low rainfall areas in the North of Ghana.

[95] UNICEF is supporting the development of the Food Based Dietary Guidelines. It is recommended to follow up with UNICEF to ensure that they can be used for SBCC activities as soon as the guidelines are finalised.

The ability to grow crops in and out of season without the influence of weather conditions or patterns makes it adaptable as farmers see it as a way to increase their performance, meet the growing need for food and sustain the economy. The creation of these **ideal micro-ecosystems through technology** enables farmers to study and become familiar with the exact needs of the plant and provide them. These structures range in size from small sheds to industrial-sized buildings: Net house (low-cost), plastic house with no electricity, to plastic house with electricity[96].

Climate and nutrition pathway(s): In Ghana, where some food crops are seasonal due to the climate, greenhouse farming ensures continual production and supply of major crops like tomatoes, which is traditionally scarce during certain seasons. This is due to the intricate design of greenhouses which allows for controlled conditions and makes it possible for crops to thrive under minimal disturbance thus affording them an opportunity to produce optimally. Greenhouses require less irrigation than normal farming since they are designed to trap moisture and as such, are not affected during the dry season. During the commissioning of seventy-five greenhouses at Dawhenya in August of 2020, the President of the Republic noted that with greenhouse technology, the reliance on favourable weather conditions and on particular seasons for vegetable farming will now be a thing of the past. Crops produced from greenhouse farming are constantly fresh and high in nutrients due to constant photosynthesis that takes place within because of carbon dioxide concentration in the enclosed space. Also, greenhouse farming yields abundantly which means consumers have more food and larger servings which creates food security year round.

Targeting: Youth (groups) in rural communities, unemployed graduates, farming communities in all parts of the country.

Recommendations for implementation:

- Invest in the availability of sufficient supplies at different locations in the country as a study shows that these are not always available.
- Strengthen the skills of youth groups on 1) maintenance of the greenhouses and 2) management of protected cultivation. The current maintenance of existing greenhouses is a matter of great concern and the knowledge level about protected cultivation is relatively low resulting in mismanagement of the greenhouse and the crops[97].
- This activity can contribute to IGREENFIN's objective to 'support the building and scaling up of the resilience and adaptive capacity of rural communities and farmers' organisations by allowing beneficiaries to access credit lines for green agricultural investments- particularly removing financial and technical barriers faced by young people.
- Learn from the design and the eligibility criteria of the new project 'Youth in Greenhouse Enterprise Project'. They promote greenhouse vegetable production and carefully select youth to which medium-term loans are offered. In addition to financial assistance, technical know-how is also provided.
- PROSPER should collaborate with the National Youth Employment Authority to provide guarantees for interested youth.
- Prosper could also explore the use of Igreenfin loans (GCF funded) as medium-term loans for youth groups. This activity can contribute to Igreenfin's objective to '*support the building and scaling up of the resilience and adaptive capacity of rural communities and farmers' organisations by allowing beneficiaries to access credit lines for green agricultural investments'*.
- More greenhouse farming centres should be created to accommodate unemployed graduates. They already have training and it wouldn't be difficult for them to use technology to regulate the farms. The youth from the rural areas with less training can be tasked with packaging and distribution.
- Training should also be organised and avenues for assistance created for traditional farmers who are willing to transform their farmlands into greenhouse farms.
- Improved infrastructure to enable easy transportation of produce to consumers and storage houses to prevent waste.

[96] Wageningen University & Research. 2014. Greenhouses in Ghana. Recommendations.

[97] Idem.

Potential Partnerships: For this activity, it is recommended to partner with MoFA/Ghana Irrigation Authority's Greenhouse Capacity Building and Training Centre (GCBTC) to deliver advanced greenhouse technologies to young people. Secondly, to collaborate with the Department of Agriculture in universities across the nation whose students are already educated on various agricultural practices, including greenhouse and livestock farming. Moreover, the youth organisations in the rural communities, the Business Development ministry in charge of the Ghana Greenhouse Farming, the Ministries of Food and Agriculture and Environment, Science and Technology and the private sector for investments.

Costs/ Unit Cost: The cost of greenhouses varies greatly depending on the size and materials used. This ranges from as low as $70.00, which is an already made small-sized walk-in greenhouse to $35,000 and above for commercial greenhouses.

5.8 Climate-smart business plans for reducing food loss and waste

Description: Globally, one third of the food produced is lost or wasted, and significant volumes of food are lost after harvest in sub-Saharan Africa each year[98]. In Ghana, food losses are in the early stages of the food chain. Each year, Ghana is estimated to lose about 20 to 30% of cereals and legumes and about 20 to 50% of roots, tubers, fruits and vegetables, in storage, during transport, or at market. Post-harvest cereal losses can be as high as 50 to 70%[99,100,101]. We propose a post-harvest oriented business intervention that addresses both quantitative and qualitative losses: support youth groups to establish and manage solar powered 1) rural and urban market cold rooms, 2) rural storage facilities with mobile dryers, and 3) vehicles and tricycles for carrying foodstuffs. When selecting groups, entities will have to submit an *Expression of Interest (EOI)* to be followed by basic business plans (there is a need to make room for groups with modestly educated individuals). The dryers will be used to dry farmers' staples (grains, vegetables, and fruits) at a fee. Storage service for farmers will also be provided at a fee. Payments could be in cash or in the form of food stuffs, with managers of such facilities selling such produce. The cold rooms will be for the perishables and will also support the dry season gardening activities. These facilities will serve both rural and urban households. The urban cold rooms are meant to sell surplus vegetables from the rural communities as well as expand the rural farmers' market base. Farmers do not have to move their food stuff, grains/cereals will be dried in various communities with the mobile dryer and transported to storage sites. Perishables will be carried from farms to cold rooms (sorted and stored). Transport of foods from rural to urban cold rooms will be done with the facility's food truck/vehicle.

Climate and nutrition pathway(s): The intervention will use energy saving technology that will contribute to reduced GHG emissions. Furthermore, reducing food losses offers an important pathway for ensuring food security, alleviating poverty, improving nutrition, and reducing environmental stress due to farming activities or expansion into fragile ecosystems to produce food that will be lost and not consumed[102]. The intervention will especially make various foods available throughout the year.

Targeting: The target group is the youth. These will be tech-savvy individuals who are energetic and willing to explore and learn new things.

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98 Affognon, H., Mutungi, C., Sanginga, P., & Borgemeister, C. (2015). Unpacking postharvest losses in sub-Saharan Africa: a meta-analysis. World Development, 66, 49-68.

99 Rutten, M. M., & Verma, M. (2014). The Impacts of Reducing Food Loss in Ghana: A scenario study using the global economic simulation model MAGNET (No. 2014-035). Wageningen UR.

100 ICIPE (2013), Postharvest Losses in Africa: Analytical Review and Synthesis.

101 World Bank (2011), Missing Food: The Case of Postharvest Grain Losses in Sub-Saharan Africa, The World Bank, Washington D.C.

102 Affognon, H., Mutungi, C., Sanginga, P., & Borgemeister, C. (2015). Unpacking postharvest losses in sub-Saharan Africa: a meta-analysis. World Development, 66, 49-68.

Recommendations for implementation:

- These groups should be given training on the rudiments of business administration.
- Activities should be devoid of alignment to any political party as partisan alignment may result in discontinuity, sustainability challenges and eventual project failure as observed in other projects[103].
- Conscious efforts should be made to link youth groups to bigger shopping centres in the cities.

Potential Partnerships: For this intervention it is recommended to work with ACDEP as they have worked with smallholder farmers on postharvest handling of foodstuff across Northern Ghana. Additionally, Ghana Grains Council (GGC) would be a good partner as it is involved in the provision of strategic value added services, including **warehouse** receipt, training and capacity building. UDS could also help in the building of cold rooms, as well as training on the usage of cold rooms.

Cost: Mobile dryer $2,400 (cost of solar powered cold rooms, grain storage facilities can't be determined by a desk review), shipment of devices, installation and training.

[103] Damoah, I. S., & Kumi, D. K. (2018). Causes of government construction projects failure in an emerging economy. International Journal of Managing Projects in Business.

6 Implementation arrangements

Suggestions for implementation arrangements have been incorporated for each individual intervention. In addition to these, more general recommendations for implementation are:

- To determine the capacities/behavioural changes needed to maximise climate and nutrition outcomes of PROSPER for all of the groups, including the elderly, adults, youth, children, people living with disabilities, extension workers, community health/nutrition workers, (private sector) value chain actors, civil society actors, traditional authorities, development partners, financial actors, academia, government partners, media and, of course, the PMU, as well as to identify suitable mechanisms to promote these behavioural changes.
- To support greater collaboration between nutrition and climate change communities, e.g. in the form of multi-stakeholder partnerships. Climate change exacerbates malnutrition through its impact on care and feeding practices, on environmental health and access to health services, and on household access to sufficient, safe and adequate food. Convening multi-stakeholder partnerships harnesses the advantages of collaboration in addressing planning issues that span more than one sectoral jurisdiction and thus require a coordinated response. Examples of relevant platforms for climate nutrition linkages include the Ghana Climate Change, Agriculture and Food Security (CCAFS) science policy dialogue platform, the national, regional and district level multi-sectoral nutrition coordination mechanisms, and the Northern Ghana Network for Development (NGND).
- For component 2.2 on enabling infrastructure development, to add an additional category for nutrition-sensitive and climate-smart infrastructures. These types of infrastructure could include small WASH infrastructures to improve access to potable water or latrines, waste disposal constructions, or drainage systems to reduce the impact of flooding on access to market or nutrition and health services. The NRLIPs will identify the need for infrastructure, hence it is critical for WASH, nutrition and climate experts to be part of the cluster development committees.
- To recruit a full-time nutrition specialist for the PMU, with expertise on nutrition-sensitive value chains and a thorough understanding of nutrition behaviours of the vulnerable groups. His/her main responsibilities would be (i) to ensure that grants and loans are only granted to initiatives/business plans that contribute to the availability and accessibility of nutritious foods, and follow up on this commitment, (ii) to ensure that SBCC activities respond to the key barriers to improving nutrition and hygiene practices for different groups in the target area, (iii) to liaise with implementation partners providing nutrition capacity, (iv) to liaise with multisectoral nutrition coordination committees, (v) to assume responsibility for nutrition-related knowledge management (including M&E and learning) and communication products, (vi) to liaise with other specialist on environment, climate, youth and gender to find synergies and address trade-offs.
- To recruit a full-time environment and climate specialist for the PMU possessing expertise on issues pertaining to climate finance. This PMU member should provide guidance to the team when it comes to alignment with national policy/finance and environmental policies, Ghana's NDCs and National Adaptation Plans, GCF processes and functional requirements. Additionally, she/he should have a good understanding of the social and economic aspects of vulnerability in order to inform the design and implementation of the targeting strategy for PROSPER. The climate specialist will support policy dialogues and analysis on the issue of climate change, and engage multiple environment and climate stakeholders, and coordinate food and nutrition security-related activities.

7 Key risks and mitigation measures

The key risk to achieving nutrition outcomes is that increased income through increased productivity, value addition, alternative livelihoods, revolving grants and more is not used by households to improve their diets. Adequate investment in nutrition SBCC for better dietary and health choices is a prerequisite to mitigate this risk, in addition to market-based strategies to improve food access. SBCC activities should address gender dynamics which affect household nutrition. In addition, it will be essential to introduce consumption measures to women's groups and other community institutions. However, the groups should be empowered to decide on the details of these measures.

For homestead food production, limited markets for cash crops and pest and disease are important risks. For this reason, beneficiaries participating in the homestead gardening intervention should be supported in the development of farming maintenance plans and market development linkages by linking farmers to urban markets and rural cold rooms. Additionally, women should employ pre-production recruitment of potential buyers as demonstrated in an earlier study in Northern Ghana[104]. For the revolving loan intervention, default repayment of loans is an important risk. To mitigate this risk, community leadership (community tribunal) should be involved or informed of the ground rules for receiving and repaying loans – this helps to enforce repayment in event of default. Women who pick loans should be accountable to the entire group not just the leadership – women will serve as checks on each other.

Ghana has a tropical climate with high mean annual temperatures in all six of the country's agro-ecological zones. The key risk for achieving climate outcomes is that there is going to be an increase in mean annual temperature of 0.1°C in Ghana. Due to changing climate and weather patterns, in combination with limitations to extend arable land area, the pressure on food production systems is likely to increase, further complicating the food and nutrition outcomes envisioned by PROSPER. The approximately 80% of smallholder farmers who depend on rain-fed smallholder agricultural systems which are generally low input, have to contend with severe climate conditions as a result of limited precipitation which may affect production in Northern Ghana, which has lower uni-modal rainfall. Thus, challenges such as droughts and pests, e.g. the fall armyworm and variegated grasshopper, are more prevalent in the North. The northern parts of Ghana are projected to become more suitable for producing groundnuts, regardless of the above scenario. However, the overall suitability of groundnuts is on the decline due to climate change.

[104] Kubuga, C. K., Dillon, A., & Song, W. (2018). Container gardening to combat micronutrients deficiencies in mothers and young children during dry/lean season in Northern Ghana. Journal of Hunger & Environmental Nutrition, 1-14.

8 M&E indicators, KM and communication

For nutrition, it is recommended that the IFAD core indicators are used. These constitute the percentage of women, 15-49 years of age, who consume at least 5 out of 10 food groups (MDD-W) ii) and the percentage of targeted individuals who have improved knowledge, attitudes and practices of food, feeding, caring and hygiene. The seasonal availability and access to nutritious foods were identified as major causes for adequate diets in Northern Ghana. Hence, M&E activities should help understand whether or not PROSPER's interventions are contributing to increased food security year round, for example, by making sure survey intervals for collecting food access and consumption data accounts for seasonality, and by adding indicators such as *Food Insecurity Expenditure Scale* and/or *Months of Adequate Household Food Provisioning*, *market level food diversity scores, etc*. The severity and magnitude of anaemia in PROSPER's target area, call for M&E design that track the project contribution to intake of iron-rich foods.

For climate and environment activities, it is recommended to have a look at the indicators developed for the IFAD Strategy and Action Plan on Environment and Climate Change 2019-2025[105]. In addition, The Environmental Protection Agency (EPA) recently published Ghana's Fourth National Communication (NC4) to the United Nations Framework Convention on Climate Change (UNFCCC)[106]. This document outlines the latest information on Ghana's progress at addressing climate change through specific policies. One of their prioritisations is to develop standard indicators for tracking adaptation actions. It is advised to align IFAD indicators to these national indicators for climate action.

To assess the impact of value chain interventions proposed in this report, we recommend an assessment *on farm/garden diversity of livestock and crops, availability of household adequacy of fruit and vegetable consumption, identification and pattern analysis of fruit and vegetable desserts* (particular location with unavailability of fruits and vegetables), *purchasing power of women/men and people living with disabilities*. These indicators should be assessed in both lean and dry seasons.

It has also been recommended to IFAD to look beyond project-level M&E frameworks and invest in frameworks at the national level that can analyse the effectiveness of climate and nutrition (policy) responses at that level. Applying M&E at the national level would require establishing logical impact pathways that link the various scales of response planning and implementation. Indicators are required to monitor progress on the status of capacity, functionality and coordination of institutions and coordination mechanisms for climate and nutrition responses. Also, indicators for mainstreaming nutrition and climate could be included, for instance, *a Climate change expert for coordination appointed within PMU*, or *a percentage of Business Plans with nutrition and/or climate benefits granted*, or *a costed climate action plan put in place at the district level*, or the *status, availability and effectiveness of a financial framework for climate response analysed*.

Costing:
The budget should include:

- Climate – nutrition-related knowledge management and communication products
- M&E activities for climate and nutrition
- Costs for organising or attending meetings to foster exchange and learning on mainstreaming climate and nutrition in an integrated manner

[105] https://www.ifad.org/en/document-detail/asset/39434396

[106] Environmental Protection Agency (EPA). 2020. Ghana's Fourth National Communication (NC4) to the United Nations Framework Convention on Climate Change (UNFCCC).

Appendix 1 Crop Suitability Maps

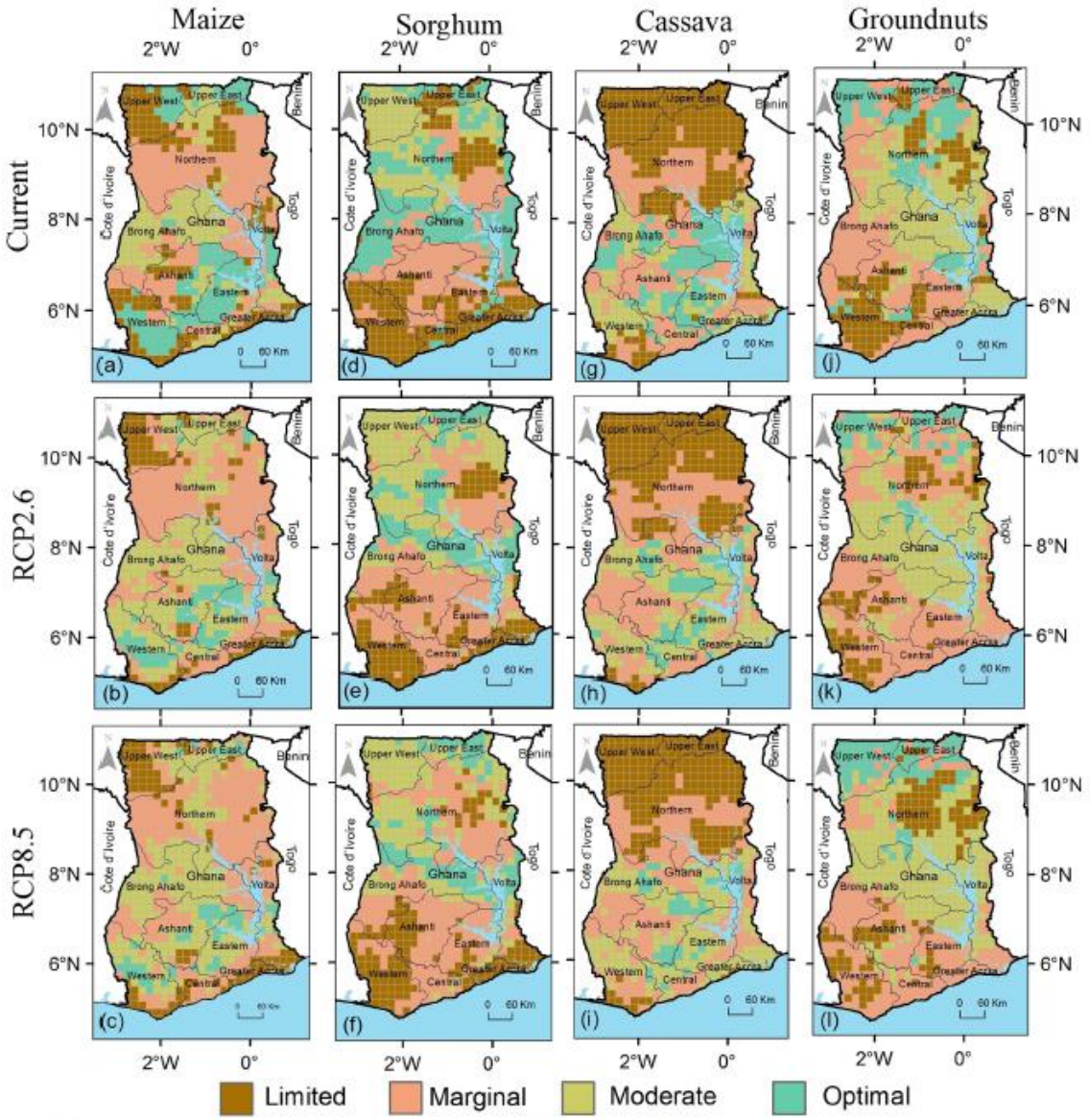

Fig 3. Suitability maps for (a) maize under current conditions (b) maize by 2050 under the RCP2.6, (c) maize under RCP8.5, (d) sorghum under current conditions (e) sorghum in 2050 under RCP2.6 in Ghana under (f) sorghum under RCP8.5, (g) cassava under current conditions (h) cassava in 2050 under RCP2.6 in Ghana under (i) cassava under RCP8.5, (j) groundnuts under current conditions (k) groundnuts in 2050 under RCP2.6 in Ghana under (l) groundnuts under RCP8.5.

Source: Chemura A et al. (2020) Impacts of climate change on agro-climatic suitability of major food crops in Ghana. PLoS ONE 15(6): https://doi.org/10.1371/journal.pone.0229881

Appendix 2 Overview of the institutional involvement in the implementation of the UNFCCC in Ghana

Climate Change Governance in Ghana

Ghana became party to the United Nations Framework Convention on Climate Change (UNFCCC), after the Parliament of Ghana ratified the instrument of the Convention in September 1995. Ten years after becoming party to the Convention in 2005, Ghana ratified the Kyoto Protocol and acceded to the Doha amendment in 2014 to extend its obligations under the Kyoto Protocol to 2020. The country has undertaken a wide range of activities as part of efforts to ensure effective implementation of the Convention.

'The Institutional arrangement within Government, mandates the Ministry of Environment, Science, Technology and Innovation (MESTI) as the lead ministry for the formulation of climate change policies and supervises the implementation of the Framework Convention on Climate Change(UNFCCC) and its Protocols within the country (Figure below). The EPA is responsible for the technical coordination of the implementation of climate programmes and thus facilitates the preparation of international climate change reports in close collaboration with sector ministries. In this regard, the EPA serves as the Convention's National Focal Point (NFP) while MESTI is the National Designated Authority (NDA) for the Clean Development Mechanism (CDM). The EPA is also the focal point for international bodies such as the Inter-Governmental Panel on Climate Change (IPCC), Climate Technology Centre and Network CTCN) and the Action for Climate Empowerment (ACE). MESTI hosts the National Climate Change Committee (NCCC), which is a multi-sectoral taskforce on climate change. The NDPC and Ministry of Finance play critical roles in the mainstreaming of climate change issues into the national development plans and the mobilisation of climate finance. With regards to the mobilisation of finance from international sources, the Ministry of Finance acts as the National Designated Authority (NDA) for the Green Climate, the EPA is the Focal Point for the Global Environment Facility. Besides, several MMDAs have either established focal units or teams to work on climate change issues in their respective ministries. For instance, the Crop Services Directorate under the Ministry of Food and Agriculture is leading the implementation of the National Climate-Smart Agriculture Action Plan for the sector. Similarly, the Climate Change Unit at the Forestry Commission is the National REDD+ secretariat. At the Energy Commission, the Renewable Energy, Energy Efficiency, and Climate Change Directorate oversees the energy and climate change issues in the sector (Figure below)'[107].

[107] Environmental Protection Agency (EPA) 2020. Ghana's Fourth National Communication to the United Nations Framework Convention on Climate Change.

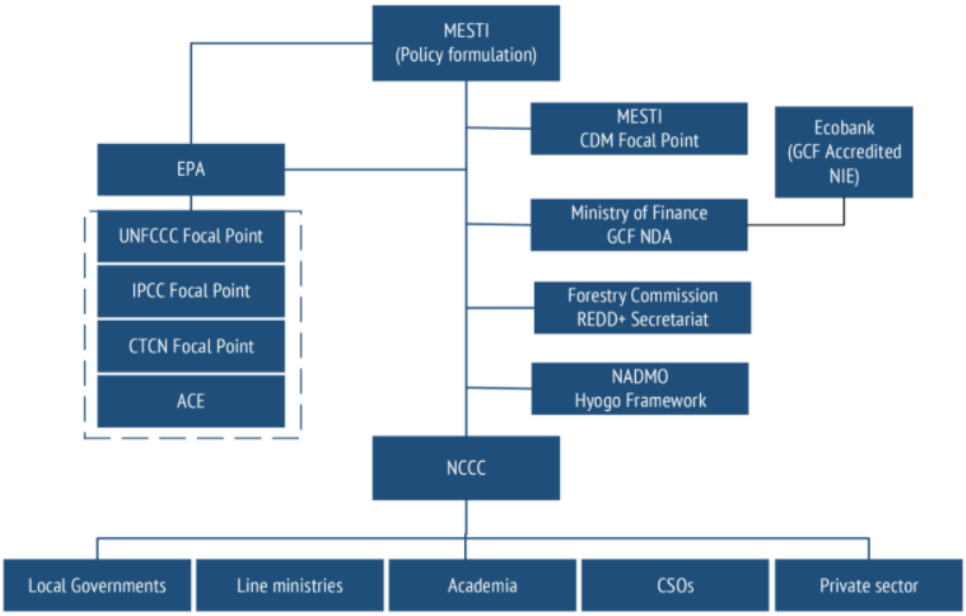

Figure 3: Overview of the institutional involvement in the implementation of the UNFCCC in Ghana

Appendix 3 FNMR Assumption used in cash flow analysis

Conventional farming / Non-FMNR	
Benefits, crop production	
	GhC/acre
Crop Revenue	**290**
Costs	
Variable	
Tractor services (year 1-30)	60
Seeds (year 1-30)	7
Fertilizer (year 1-30)	60
Pesticides (year 1-30)	2
Total hired labour (year 1-30)	45
Pruning (year 1-3)	
Thinning (year 4-30)	
Fixed	
Training of fire volunteers	
Training of lead farmers	
Equipment fire volunteers	
Equipment lead farmers	

FMNR & SLM scenario			
Benefits, crop production			
	GhC/acre		
Crop revenue, at outset	**290**		
Crop revenue, after 5 years	**540**		
Annual increase in crop revenue (year 0-4)	50		
Costs			
Variable			
Tractor services (year 1-30)	125		
Seeds (year 1-30)	22		
Fertilizer (year 1-30)	60		
Pesticides (year 1-30)	2		
Total hired labour (year 1-30)	90		
Pruning (year 1-3)	40		
Thinning (year 4-30)	20		
			Note
Fixed, CIKOD	**Per acre**	**Per household**	
Training of fire volunteers	16	32	Costs borne by CIKOD
Training of lead farmers	16	32	
Equipment fire volunteers	7,6	15,2	
Equipment lead farmers	20,5	41	
Fixed, farmers	40	80	

On-farm forest production		
Trees per acre, by species	Mature	Young
# ebony tree per acre	2	0
# shea tree per acre	1	0
# dawadawa tree per acre	1	0
# mango tree per acre	1	0
# neem tree per acre	0	0
Total trees	**5**	**0**

On-farm forest production		
Trees per acre, by species	Mature	Young/newly nourished
# ebony tree per acre	2	3
# shea tree per acre	1	2
# dawadawa tree per acre	1	1
# mango tree per acre	1	1
# neem tree per acre	0	1
Total trees	**5**	**8**

Benefits, forest products				
	Mean yield/tree/year	**Min**	**Max**	**Price**
Ebony fruit, young, yr 1-14 (bags)	0	0		47
Ebony fruit, mature, yr 15-30 (bags)	0,75	0,3	1,5	
Marginal yearly increase, yr 14-30 (bags)	0,1			
Shea nuts, young, yr 1-14 (kg)	0	0		1,9
Shea nuts, mature, yr 15-30 (kg)	15	7	26	
Marginal yearly increase, 14-30 (kg)	1			
Dried dawadawa seed, yr 5-15 (kg)	0	0		3
Dried dawadawa seed, yr 16-30 (kg)	90	10	90	
Marginal yearly increase, yr 16-25 (kg)	10,0			
Mango fruit, young, yr 3 -7 (fruit)	105	10	200	0,8
Mango fruit, mature, yr 4 -30 (fruit)	200			
Marginal yearly increase, yr 3-7 (fruit)	38			
Fuelwood				
From prunings, mature trees, yr 10-30 (headloads)	6	5	7	5
From prunings, cluster of sapling, yr 1-3 (headloads)	0			
Marginal yearly increase, yr 6-9 (headloads)	0			
From thinnings of young trees, yr 4-10 (headloads)	0			
	Conversion factor			
Potential -> Realistic harvesting of fruits and nuts	0,5			

Benefits, forest products				
	Mean yield/tree/year	**Min**	**Max**	**Price**
Ebony fruit, young, yr 1-14 (bags)	0	0	0	47
Ebony fruit, mature, yr 15-30 (bags)	0,75	0,3	1,5	0
Marginal yearly increase, yr 14-30 (bags)	0,1	0		
Shea nuts, young, yr 1-14 (kg)	0	0	0	1,9
Shea nuts, mature, yr 15-30 (kg)	15	7	26	
Marginal yearly increase, 14-30 (kg)	1,4	0		
Dried dawadawa seed, yr 5-15 (kg)	0	0		3
Dried dawadawa seed, yr 16-30 (kg)	90			
Marginal yearly increase, yr 16-25 (kg)	10,0			
Mango fruit, young, yr 3 -7 (fruit)	105	10	200	0,8
Mango fruit, mature, yr 4 -30 (fruit)	200			
Marginal yearly increase, yr 3-7 (fruit)	38			
From prunings, mature trees, yr 10-30 (headloads)	6	5	7	5
From prunings, cluster of sapling, yr 1-3 (headloads)	1,5	1	2	
Marginal yearly increase, yr 6-9 (headloads)	2			
From thinnings of young trees, yr 4-10 (headloads)	2			
	Conversion factor			
Potential -> Realistic harvesting of fruits and nuts	0,5			

Source: https://regreeningafrica.org/wp-content/uploads/2020/04/ELD-Ghana-Report_22_March-web2.pdf

Appendix 4 CSA practices in agricultural value chain segments Ghana

4.a Lawra district - example of Guinea Savanna zone

Annex 3.7: CSA practices Identified in the Agricultural Value Chain Segments

Value Chain Segment	CSA Practice	Farming Systems involved
Production	Minimum tillage	Maize, sorghum, millet, cowpea
	Irrigation	Rice, Maize, tomatoes, pepper, garden eggs, okro,
	Mixed farming	All major crops and livestock
	Bunding	Cereals(Rice, sorghum, millet, maize)
	Stone lining	Cereals (sorghum, millet, maize), legumes
	Compost application	Cereals(sorghum, millet, maize) and vegetables
	Bush fire control	All crops and livestock
	Mulching	Vegetables, yam
	Cover cropping	Maize, sorghum, millet, (cowpea, mucuna, bitter melon, pumpkin)
	Improved seed	Maize,(varieties such as Wangdatan, Abrohemaa, obatanpa) Cowpea (Varieties such as sogotera, asontem, apagbala,) Sorghum (varieties such as kapala, doorado) Soyabean(Varieties such as jenguma, afayak), Groundnuts (Chinese, Sama 22 and 23,Manipinta)
	Intercropping	Maize- millet, maize- cowpea, millet-cowpea, groundnut- bitter melon, sorghum-cowpea, sorghum-maize, maize-okro, Yam-maize
	Mixed cropping	Maize, yam, cowpea, okro, pepper, tomatoes, bitter melon
	Integrated Nutrient Management (fertilizer, manure)	Rice, Maize, sorghum, yam(manure), okro, vegetables
	Weather information/Extension education	All crop and livestock
	Pests and disease control	All crop and livestock
	Soil and Water management	All crop and livestock
	Ridging	Cereals, vegetables, legume
	Stone lining	Cereals, legumes
	Livestock Tethering	Goats, sheep, cattle, pigs
	Improved housing	Livestock and poultry
	Supplementary feeding	Livestock and poultry
	Crop rotation	Cereal-legume rotation
	Improved breeds (hybrids)	Sahelian sheep and goats, poultry
Processing	Solar drying	Cereals, legumes, okro, tomatoes, leafy vegetables, pepper
	Oven Smoking of meat	All meat and fish
Marketing	Storage of crops e.g.	Cereals, legumes, root and tubers, leafy vegetables
	Use of hermitic bag	Cereals and legumes
	Use of airtight bags to store cowpea	Cereals and legumes
	Use of actelic	Cereals and legumes
	Solar Drying	Cereals, legumes, root and tubers, leafy vegetables

4.b Lawra district - example of Guinea Savanna zone – Gender

Annex 3.8: Identified CSA practices, (%) attributed gender utilization and associated constraints in the Lawra District

CSA practices	Adult		Youth		Constraints
	Male (%)	Female (%)	Male (%)	Female (%)	
Minimum tillage	20	10	60	10	Female were having problems and difficult to wear knapsack sprayer
Irrigation	30	10	40	20	Women has challenge in digging out wells and are not financially sound to hire labour
Mixed farming	40	20	35	5	Due to the reproductive roles of most women, they find it difficult to practice mix farming
Bunding	35	5	55	5	Mostly done with hoes and tedious for women
Stone lining	30	20	40	10	Tedious for women to practice and also not have enough finance to hire labour
Compost application	20	30	40	10	Lack of technical know-how and limited time to search for compost materials due to their reproductive roles.
Bush fire control	30	20	40	10	Women don't have rights to make bye-laws with regard to bush fires. They don't also have the strength and encourage to control bush fires.
Mulching	30	50	15	5	Mulching materials are not easily available, women move to long distances in search of the materials.
Cover cropping	10	60	20	10	In adequate education in the use of cover crops
Improved seed	40	10	40	10	Women use local variety mostly, because they are financially handicapped.
Intercropping/ Mixed cropping	20	50	5	25	Time consuming to maintain farm and difficult to apply weedicide.
Integrated Nutrient Management (fertilizer, manure)	60	20	15	5	Cost of fertilizer constraint most women.
Weather information/Extension education	20	60	15	5	In adequate female extension agents and mostly women gets information from their husbands.
Pests and disease control	60	10	25	5	Cost of chemicals and adult women find it difficult to handle spraying machine. Exposure to chemicals is risky
Soil and Water management	40	30	20	10	Cost of fertilizer constraint women to use, and drainage construction is tedious for women.
Livestock Tethering	10	60	20	10	Tethering makes it easy to steal the animals.
Improved housing	60	10	25	5	Lack of financial resources to construct and maintain houses
Supplementary feeding	20	50	25	5	Difficulty in obtaining feed materials during the dry season for ruminants.
Improved breeds	40	10	40	10	It involve cost to buy improved breed

4c. Forest Transition zone:

Annex 4.6: Actors' Engagement in Agricultural Value Chain Segments by Gender in Offinso North District

Value chain segments	Male Adult (%)	Female Adult (%)	Youth Male (%)	Youth Female (%)
Production	**40**	30	12	18
Processing	10	**70**	5	15
Marketing	5	25	10	**60**
Service Provision (Direct Agric services, Financial Institution, market information)	20	10	**50**	20

Annex 4.7: CSA practices Identified in the Agricultural Value Chain Segments

Value chain segment	CSA Practices	Farming Systems involved
Production	Minimum tillage	Maize, Groundnuts, Cowpea, Mango, Cashew, Orange, Cocoa, Oil Palm, Plantain, Cassava, Yam, Cocoyam, Tomatoes, Vegetables (Pepper, Okro, Garden eggs, Cabbage, Onion, Carrot, Lettuce, Cucumber)
	Irrigation	Rice, Maize, Cowpea, Mango, Cashew, Orange, Cocoa, Oil Palm, Tomatoes, Vegetables (Pepper, Okro, Garden eggs, Cabbage, Onion, Carrot, Lettuce, Cucumber)
	Mulching	Maize, Mango, Cashew, Orange, Cocoa, Oil Palm, Plantain, Cassava, Yam, Cocoyam, Tomatoes
	Brushing/Slashing	Maize, Cowpea, Mango, Cashew, Orange, Cocoa, Oil Palm, Plantain, Cassava, Yam, Cocoyam, Tomatoes, Vegetables (Pepper, Okro, Garden eggs, Cabbage, Onion, Carrot, Lettuce, Cucumber)
	Cover cropping	Cowpea, Mango, Cashew, Orange, Cocoa, Oil Palm, Plantain, Yam
	Improved planting materials (more local seeds used)	Rice, Maize, Groundnuts, Cowpea, Mango, Cashew, Orange, Cocoa, Oil Palm, Plantain, Cassava, Yam, Cocoyam, Tomatoes, Vegetables (Pepper, Okro, Garden eggs, Cabbage, Onion, Carrot, Lettuce, Cucumber)
	Intercropping	Rice, Maize, Groundnuts, Cowpea, Mango, Cashew, Orange, Cocoa, Oil Palm, Plantain, Cassava, Yam, Cocoyam
	Mixed cropping	Rice, Maize, Groundnuts, Cowpea, Mango, Orange, Cashew, Orange, Cocoa, Oil Palm, Plantain, Cassava, Yam, Cocoyam
	Planting in lines	Maize, Mango, Orange, Cashew, Plantain, Tomatoes, Vegetables (Pepper, Okro, Garden eggs, Cabbage, Onion, Carrot, Lettuce, Cucumber)
	Crop rotation	Cereal and legumes

Value chain segment	CSA Practices	Farming Systems involved
	Integrated Nutrient Management (fertilizer, manure)	Rice, Maize, Cashew, Cocoa, Yam, Tomatoes, Vegetables (Pepper, Okro, Garden eggs, Cabbage, Onion, Carrot, Lettuce, Cucumber)
	Weather information	All crops, livestock and poultry
	Soil and Water management	All crops, livestock and poultry
	Pests and disease control	All crops, livestock and poultry
	Improved housing	All livestock and poultry
	Supplementary feeding	
	Erection of stand or platform in the pen to prevent foot rot	Local fowl, Sheep, Goats, Pigs
	Improved breeds (hybrids)	All livestock and poultry
Processing	Solar/sun drying	Rice, Maize, Groundnuts, Cowpea, Cashew, Cocoa, Oil Palm, Plantain, Cassava, Tomatoes, Vegetables (Pepper, Okro, Onion)
	Reduced fermentation period during rainy season	Cocoa
	Oven Smoking of meat	All livestock and poultry
	Use of LP Gas	All crops, livestock and poultry
Marketing	Storage of produce using hermitic/PIC bag or actelic	Cereals (maize)
	Use of airtight bags to store gari	Cassava
	Early carting to avoid spoilage	Oil Palm, Plantain, Cassava, Yam, Tomatoes, Vegetables (Pepper, Okro, Garden eggs, Cabbage, Onion, Carrot, Lettuce, Cucumber)

Annex 4.8: Identified CSA practices, (%) attributed gender utilization and associated constraints in the Offinso North District

No.	CSA practices	Adult		Youth		Constraint
		Male (%)	Female (%)	Male (%)	Female (%)	
1	Minimum tillage	30	20	30	20	Labour intensive
2	Irrigation	30	10	50	10	High energy cost
3	Mulching	45	30	5	20	Scarcity of mulching materials esp. during dry season
4	Brushing/Slashing	35	25	30	10	Rapid re-growth of weeds
5	Cover cropping	20	45	5	30	Difficulty in getting seeds and also the cost of seeds is expensive
6	Improved planting material	30	20	30	20	Scarcity of planting materials
7	Intercropping	20	45	5	30	Possibility of transmitting diseases and pests from one crop to the other
8	Mixed cropping	20	45	5	30	Possibility of transmitting diseases and pests from one crop to the other
9	Row planting	10	5	75	10	Very laborious
10	Crop rotation	30	15	35	20	Poor selection of crops can lead to disease build up
11	Integrated Nutrient Management (inorganic fertilizer, manure)	20	20	30	30	Very laborious in application of manure and very bulky
12	Weather information	30	30	20	20	Lack of weather stations in the district
13	Soil and Water management	40	40	10	10	Lack of technical knowledge on the part of farmers
14	Pests and disease control	30	20	30	20	High cost of inputs (pesticides)
15	Improved housing	40	20	30	10	High cost of materials
16	Supplementary feeding	20	40	20	20	High cost of feed
17	Erection of stand or platform in the pen to prevent foot rot (Not many practiced)	40	10	40	10	High cost of building materials
18	Improved breeds (hybrids)	35	10	35	20	Lack of access of improved breeding materials
19	Solar/sun drying	20	40	15	35	High initial construction cost
20	Oven Smoking of meat/Use of LP Gas	15	40	15	30	Inadequate LPG stations
21	Storage of produce using hermitic bag or actelic	50	10	30	10	Farmers lack requisite skills for the use of chemicals

Appendix 5 Stakeholder and Intervention Mapping

Stakeholder and intervention mapping - Food and Nutrition Security

No.	Project	Main objective	Main activities	Partners	Target group	Location	Lessons learned which are relevant to PROSPER
1	Scaling Up Local Capacity to Innovate for Food and Nutrition Security (**SULCI-FaNS**)	Strengthen the innovation capacities of rural communities, particularly of women and improve food and nutrition security and increase local resilience to change	• Document relevant local innovations in the area of food and nutrition security and promote local innovation • Promote gender equality and women's development • Engage in policy dialogue for scaling up farmer innovation	Misereor - Germany, Prolinnova-Ghana, Association of Church-based Development Projects (ACDEP), Navrongo-Bolgatanga Catholic Diocesan Development Organisation (NABOCADO), Center for Ecological Agriculture and Livelihood (CEAL)	Rural communities, particularly of women	Bongo District (Upper East Region), West Mamprusi Municipal (Northeast Region)	Build on smallholders preferences and indigenous knowledge.
2	Sustainable Poverty Reduction in Northern Ghana (**SPRING**)	Productive and resilient rural communities with enhanced incomes, increased food security and effective natural resource management.	• Improve agricultural production and performance • Increase and diversified income opportunities for men and women • Improve environmental and natural resource management • Enhance capacity of communities to develop economically, socially and environmentally sustainable livelihoods	USAID, CHF, ACDEP MoFA, GHS	Rural men and women in select communities / districts	Northern Ghana	Impact of projects of this nature are difficult to measure when baseline information is not gathered.

No.	Project	Main objective	Main activities	Partners	Target group	Location	Lessons learned which are relevant to PROSPER
3	Local food for improved nutrition	Reduce stunting and micronutrient deficiencies among children under 2 years in Northern Ghana	• Support smallholders • Support value chain development at the industrial/community level. E.g. Corn-soy blend (Maizoya) Groundnut-based mixed (GrowNut) • Link farmers & processors to markets	World Food Programme	Children under 2 years	Northern Ghana	For sustainability and acceptance: build on locally available resources, technologies, and indigenous knowledge.
4	Multinational NERICA rice distribution project: Towards sustainable agriculture	Improve food security and reduce poverty for farming households	Provision of seeds and training/technical support	ADB/MoFA	Farming households	Nation-wide	Targeted crops should be evaluated for acceptability with farmers and traders before full scale implementations. There should be more than one target crop in order for selection based on suitability & choices to prevent the feeling of imposition.
5	Household Food Security Project in Northern Ghana	Increase family food production and incomes of rural women by up-scaling ecologically appropriate production practices and technologies and supporting economically viable activities of women that enhance the promotion of sustainable agriculture.	• Strengthen the capacity of rural communities • Promote the adoption of community participatory technology development and sustainable agriculture	ACDEP and CHF - Canada	Rural women	Northern Ghana	Participatory Technology Development approach has worked as a community and farmer empowerment strategy for achieving sustainable food security and poverty reduction. Multi-partners and NGOs have different priorities and must be managed well.

No.	Project	Main objective	Main activities	Partners	Target group	Location	Lessons learned which are relevant to PROSPER
6	Livelihoods Empowerment Against Poverty **(LEAP)**	Provision of cash transfer support to bolster the marginalised population	• Social cash grant transfer for poor households	Ministry of Gender and Child Protection, DFID, World Bank and UNICEF	The poorest households in Ghana. Orphans and vulnerable children, persons with disabilities, aged 65 and above with no support, pregnant women and children under 1 year.	Nation-wide	
7	*Jumpstarting orange-fleshed sweet potato in West Africa through diversified markets*	*Increase nutritional and economic benefits of OFSP for rural smallholder farmers and women by developing the markets and nutritional value chains, and building sustainable seed systems and increasing production of OFSP in target rural communities to respond to market demand.*	• Improve farmer groups' skills related to production of OFSP seed (vines) and sweet potatoes for markets • Identify potential institutional and other diversified markets • Help to create and enhance market demand for OFSP in the target areas • Link farmer organisations to credit services and input markets	The International Potato Center, ACDEP	Farmer groups		Weak institutional coordination and collaboration undermines project's impact
	Resiliency in Northern Ghana (RING)	Improve the livelihoods and nutritional status of vulnerable households in targeted communities in 17 districts of the Northern Region	• Improve quality of food consumed by women and children • Improve access to savings and loans • Explore alternative income streams, and promote diverse nutritious crop production and consumption • BCC for Nutrition & WASH	USAID; UDS John Snow Institute; NRCC; metropolitan, Municipal and District Assemblies.	Women and children	Northern Ghana	
8	Food-based dietary guidelines.	Develop dietary guidelines for Ghana	Generate evidence on practices and behaviour.	UNICEF, MoFA and University of Ghana	Ghanaian population	Nation-wide	

Stakeholder and intervention mapping – Climate change

Nr.	Project	Main objective	Main activities	Partners	Target group	Location	Lessons learned which are relevant to PROSPER
1	Programme on Affirmative Finance Action for Women in Africa (AFAWA): Financing Climate-Resilient Agricultural Practices in Ghana	Empowering vulnerable women groups in the country's most vulnerable agricultural zone through Line of Credit (LoC) and technical Assistance (TA) to improve their participation in low-emission, climate-resilient agricultural practices	**1. Capacity** building for CRA adoption practices and technologies uptake **2. Technical** Assistance for LFIs GH and MSMEs/FBAs to support implementation of the programme **3. Technical** Assistance for strengthening the regulatory framework for private sector investment in climate-resilient agriculture **3.Advocacy**, knowledge management and dissemination of outputs	1. Ministry of Finance (MoF), 2. Accredited entity African Development Bank (AfDB)	**1. 400 women-led** farmer-based associations (FBAs) and agribusiness MSMEs **2. Local** financial institutions **3. Indirect** beneficiaries are 373,720.	Northern and Mid Ghana	**1. Affordable** loans to micro, small, medium-sized enterprises (MSMEs) and farmer-based associations (FBAs) led by women who will adopt low-emissions and climate-resilient agricultural practices in Ghana **2. Technical** assistance for adoption of low-emission and climate-resilient practices for MSMEs and a local bank, enhancement of regulatory framework and knowledge dissemination
2	Adaptation Learning Program for Africa (ALP)	To increase the capacity of vulnerable households in Sub-Saharan Africa to adapt to climate variability and change. Empowering communities and civil society organisations in decision-making on adaptation	Building adaptive capacity at the household and individual level by building resilience of livelihoods and reducing disaster risks, particularly for the most vulnerable groups.	UK Government (UK Aid); Danish International Development Agency; Government of Finland; Austrian Development Authority CARE International - Ghana, with local partners and CSOs in the north	Civil Society Organisation, Community Based Organisation, Women groups	Northern Ghana	**1.Develops** and applies innovative approaches to Community-Based Adaptation (CBA) to generate best practice models; **2. Empowers** local communities and civil society organisations to have a voice in decision-making on adaptation; **3. Promotes** best practice models for CBA among adaptation practitioners; and **4. Influences** national, regional and international adaptation policies and plans.
3	Adaptation of Agro Ecosystems to Climate Change in Ghana	Pilot measures help to define agricultural sector policy and national support measures for the adaptation of land use systems to climate change	Capacity building; policy formation and integration; CBA Plant demonstration samples of drought-resistant maize	German Federal Ministry for Economic Cooperation and Development (BMZ) Ghana Ministry for Food and Agriculture; Savannah Agricultural Research Institute;	Savannah and transitional region of Ghana	Savannah and transitional region of Ghana, particularly Brong Ahafo and Northern regions	Cooperation with small farmers, tried-and-tested measures designed to facilitate adaptation to climate change. 600 farmers provided with weather forecasts by mobile

Nr.	Project	Main objective	Main activities	Partners	Target group	Location	Lessons learned which are relevant to PROSPER
			varieties in the 16 communities	Ghana Meteorological Agency			phone to enable them to better plan their agricultural activities. The Ghana Meteorological Agency is equipped with automatic weather stations in the eight project districts to sustainably improve weather forecasting for the region.
4.	Increased Resilience to Climate Change in Northern Ghana through the Management of Water Resources and Diversification of Livelihoods	To enhance the resilience and adaptive capacity of rural livelihoods to climate impacts and risks on water resources in the northern region of Ghana	Water resource management and planning under climate change Community level implementation of climate-resilient water resource management activities Diversification of livelihoods of rural communities under climate change	UN Development Programme Ministry of Environment, Science, Technology and Innovation	Women group CSOs	Upper East, Upper West and Northern Regions of Ghana	IFAD can learn from the use of grants approach where funds were disbursed to about 43 NGOs to implement livelihood component.
5	Promoting a Value Chain Approach to Climate change Adaptation in Agriculture in Ghana	To promote activities that reduce climate-induced risks to the achievement of food security and income generation objectives for the rural communities in Ghana.	Awareness raising on climate change and capacity to address impacts along the cassava value chain/other complementary food crop production. Support adaptation to climate change of cassava production Promote innovative adaptation solutions along the agriculture value chain	**IFAD** **Government institution** (Ministry of Environment, Science and Technology (MEST); Ghana Meteorological Service (GMET); Business Advisory Centres at the District Assemblies and the District Development Officers (DDOs) **NGOs/CSOs** (Savannah Agricultural Research Institute, Nyamkpala; the Soil Research Institute, Kwadaso; the Kwame Nkrumah University of Science and Technology, Kumasi; the Koforidua Polytechnic, Koforidua; the	Asset-poor, food-insecure and labour-deficient farm households Small-scale R&T processors Asset-poor operators in the R&T commodity chains	Ashanti, Brong Ahafo, Northern and Volta Regions	**Knowledge:** The main barriers to small scale farmers adopting climate-smart agriculture included a lack of knowledge, inadequate technical support, poor access to inputs and credit and unfavourable market structure Upscale the gains in knowledge and understanding made in cassava climate-smart agriculture throughout all of IFAD operations as well as MOFA The project suffered unsatisfactory oversight and management of project activities

Nr.	Project	Main objective	Main activities	Partners	Target group	Location	Lessons learned which are relevant to PROSPER
				Forestry Commission; District Assemblies)			Project has lacked the adequate initiative to secure the necessary technical assistance and support services
6	Greater Rural Opportunities for Women	To improve food security, by helping women farmers increase availability, access, and utilisation of a variety of appropriate and nutritious foods through strengthening production and market linkages, increasing diversification in production, and creating nutrition awareness	Training on household gardens to produce additional nutritious food to consume or sell; Creation and strengthening of market linkages, connecting women producers and processors to small and large-scale buyers; Facilitation of interactions between project partners, including financial institutions, credit unions, and clients; Increasing the availability and utility of rainwater harvesters to clients; Expanding the economic benefits of village savings and loans among clients towards increasing livelihoods Policy and stakeholder engagement to address land tenure issues to improve women's access to productive land Facilitation for women to purchase locally available, appropriate agricultural technologies through a matching grant Technology Fund to improve women's access to technological innovations;	**Canadian partner:** Mennonite Economic Development Associates (MEDA) **Local partners:** Tumu Deanery Rural Integrated Development Programme (TUDRIDEP), Professional Network North (ProNet), Community Aid for Rural Development (CARD), Capacity Enhancement and Community Support (CAPECS) and Partnership for Rural Development Action (PRUDA).	23,368 female farmers cultivating soybeans in rural Upper West Region of Ghana and over 163,879 secondary beneficiaries	Upper West Region, Ghana	Men are effective agents of change in the economic empowerment of women within patriarchal cultures. Interventions that target barriers to women's economic empowerment are successful when capacity development and the creation of long-term, sustainable partnerships are rooted in local market conditions Development partners can realise significant gains for beneficiaries of agricultural investments by harnessing their reputation, networks, and existing trust with market actors.

Nr.	Project	Main objective	Main activities	Partners	Target group	Location	Lessons learned which are relevant to PROSPER
7.	Climate Change Adaptation in Northern Ghana Enhanced (CHANGE)	To support smallholder farmers to improve their adaptive capacity and build their resilience against the impacts of climate change on agriculture, food security and livelihoods.	**Climate Adaptation** To increase access to information about climate change and its effects, and to strengthen the capacity of female and male smallholder farmers to implement adaptive actions. **Agricultural Training** To train agricultural extension agents, farmers, and farmer-based organisation leaders to implement climate-adaptive agriculture practices that build community resilience to the impacts of climate change. **Gender Equality** To increase women's participation in sustainable agricultural and alternative livelihoods.	Government of Canada through the Department of Foreign Affairs, Trade and Development (DFATD) Farm Radio International UNIFOR CARE Ghana Ghana Meteorological Agency (GMet) Ghana Ministry of Food & Agriculture (MoFA) Savannah Agriculture Research Institute (SARI) University for Development Studies, Tamale, Ghana RAINS, TAI and TUDRIDEP	Female and male smallholder farmers in 17 communities	NORTHERN Ghana	**Gendered approach**: The CHANGE gender strategy – targeting women for specific inclusion in agricultural training and leadership opportunities, and for specific types of agricultural and non-agricultural income generation – produced significant benefits, and should be continued and furthered in future projects. **Land access**: The constraints on land tenure should be addressed in an even more participatory manner, and more work needs to be done to address the systemic inequities that prevent women from gaining access to fertile land. **Credit scheme:** Future projects that involve credit should have a continuous capacity-building component that targets potential beneficiaries and financial institutions. Beneficiaries should be trained on credit, accounting and financing; and should be supported to invest effectively. There also needs to be a well-understood system of loan repayment. Ongoing collaboration between CFTC, SARI and other research institutions could help expand the scope of support for indigenous crop cultivars beyond those currently in use.

Appendix 6 List of interviewees

Name	Organisation & Position	Topic
Dr. Daniel Tutu Benefoh	Environmental Protection Agency: National Climate Change Focal Point to the UNFCCC	Climate data, climate information services & communication
Dr. Antwi Bosiako-Amoah	Environmental Protection Agency: National Focal Point, Climate Change Adaptation	Adaptation, agroforestry, climate finance, women & youth, institutional collaboration/partnerships
Mr. Kingsley Amoako	Ministry of Food and Agriculture: Director, head of environment and CC unit	Climate-Smart Agriculture
Vincent Botchway	Council for Scientific and Industrial Research, Animal Research Institute	Climate-Smart Agriculture, Agribusiness
Foster Aboagye Gyamfi	Ministry of Finance, GCF NDA Secretariat: Principal Economics Officer	Climate finance
Ms. Rhoda Donkor	Forestry Commission, Climate Change Directorate	Gender Officer, Climate Change, NRM
Wilfred Nelson	National Development Planning Commission: Deputy Director	Climate Change Adaptation, integrated approaches, climate extension services
Mrs. Kawusada Abubakar	NORSAAC: NGO women and youth empowerment Northern Ghana: Gender and Governance Manager	Gender dynamics and climate change
Ms. Ruth Situma Dr. Priscilla Wobil Mrs. Porbilla Ofosu-Apea Mr. Jevaise Aballo	United Nations Children's Fund: Nutrition & Health	Implement nutrition interventions Technical & financial support Infant and Young Child feeding education Micronutrients supplementation
Prof. Saa Dittoh	University for Development Studies: WACWISA	Postgraduate Teaching Projects (promotion of smallholder agriculture especially in relation to food and nutrition security, sustainable agricultural and food systems, irrigation and agricultural water management technologies)
Ms. Gloria Kobati	Ministry of Health - Nutrition	Nutrition Education & promotion Maternal & child nutrition Infant and young child feeding Micronutrient supplementation and education
Mr. Alex Osei Yeboah	World Food Programme: Nutrition & Food Security	Formulation & Fortification of Food Technical & financial support (Smallholder farmers, private sector) Support companies to produce & market complementary foods School feeding programme
Dr. Edmund and his team	Ministry of Food and Agriculture - GASIP	GASIP Mainstreaming climate change adaptation Value chain interventions to ensure sustainable production systems Improve the resilience of smallholders against the negative impacts of changing climatic conditions
Ms. Fati Abdulai	Widows and orphans movement – Local NGO	Economic & Social Empowerment. Sustainable Agricultural Practices; Value chain development – Shea, Legumes, Nim, Boabab, etc.
Dakpenyili Soy Farmers' group	CBOs	Soy, Rice, Maize, vegetable farming
Mr. Abdul Fatawu Ms. Joyce Antoinette Kulevo	LEAP	PLW, nutrition component in the LEAP programme, targeting vulnerable households

Appendix 7 Terms of reference

Date: 04 September 2020

Subject: *Terms of Reference for the Pre-Design Study mission to Ghana on 'Climate adaptation and mitigation measures for nutrition co-benefits in IFAD investments' (dates)*

Background

1. Climate change and food and nutrition security are strongly interlinked. Firstly, increased evidence shows that, climate impacts affect nutrition by influencing food production systems, e.g. through physiological effects on crops or changes in water and soil resources, but also by facing increased weed and pest challenges, or changes in the interplay between pathogens and livestock. Water systems and their management and sanitation environments are stressed by rising sea levels, flood risks or increasing temperatures and with that the risk for vector-borne diseases, like dengue. This has an impact on livelihood choices, labour options and time allocated for caregiving and other nutrition-related activities. Therefore, climate change undermines current efforts to reduce hunger and promote nutrition. It is estimated that in all regions where stunting is already severe, climate change will increase stunting by 30-50 percent by 2050.

2. Food production in its turn impacts climate change. Systems of food production release greenhouse gases (e.g., carbon dioxide, methane, and nitrous oxide) into the atmosphere directly and drive land use change that releases additional carbon dioxide when forests are cleared, wetlands drained, and soils are tilled. Food production is a prime source of methane, and nitrous oxide, which respectively have 56 times and 280 times the global warming potential (over 20 years) of carbon dioxide. Methane is produced during digestion in ruminant livestock, such as cows and sheep, or during anaerobic decomposition of organic material in flooded rice paddies. Nitrous oxide mainly arises from soil microbes in croplands and pastures and is affected by soil fertility management, such as fertiliser application[108].

Justification for the mission

3. Against this background, IFAD designed a project on adoption of climate adaptation measures, which increase nutrition co-benefits for smallholder farmers and their families. The project is titled 'Climate change and nutrition in value chain development' and is funded under ASAP 2 (Adaptation for Smallholder Agriculture Programme - Phase II) and was approved in a memo signed on 6th August 2019. The project aims to develop a well-proven methodology and approach to support project designs/mid-term reviews and to strengthen the capacity of IFAD teams to conduct comprehensive and integrated assessments at project design that allow for the identification of adaptation and mitigation actions, while also reducing nutrition risks of food value chain investments.

4. In order to implement most of the activities of the above initiative, the provision of high quality technical support has been requested by IFAD from Wageningen Centre for Development Innovation (WCDI). WCDI support will allow IFAD to develop an integrated approach for designing climate-smart and nutrition-sensitive projects, hereby contributing to the operationalisation of IFAD's transformational framework for mainstreaming themes and to reinforce capacities of local actors.

5. This technical support provided by WCDI includes the three pre-design studies for three projects, in three IFAD supported countries, namely:
   - Project on Regeneration of Livelihoods Landscapes (P-ROLL) in Lesotho (April – June 2020)
   - Smallholder Agriculture Cluster Project (SACP) in Zimbabwe (April-June 2020)

[108] Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems, The Lancet Commissions, February 2019.

- **Livelihood and Productivity Enhancement of Smallholder Farmers Project (PROSPER) in Ghana**

6. The pre-design study for Ghana is planned in line with the planning scheduled for the full design of PROSPER. The overall goal of this six-year project is to contribute to sustainable poverty reduction, a healthy rural population and reduced income uncertainties due to climatic change in Ghana.

Main objective of the mission:

7. To conduct a pre-design study mission for Ghana with the aim of exploring opportunities for climate adaptation and mitigation, as well as nutrition actions for future IFAD investments in Ghana (forthcoming: PROSPER). Because of the COVID-19 crisis, this mission will be conducted in a remote manner.

Specific objectives of the mission:

- To reflect on the lessons learned related to climate and nutrition in previous and current IFAD investments in Ghana and on their implications for the design of PROSPER.
- To assess to what extent the lessons and recommendations of the *General literature review on food system interventions with climate and nutrition co-benefits,* can be applied to the Ghanaian context.
- To review the main government and donor supported climate-nutrition initiatives and pre-screening potential partners for collaboration with PROSPER.
- To consult with selected key stakeholders to describe the present climate adaptation, mitigation and nutrition landscape, and validate proposed pathways and actions.
- To formulate appropriate pathways and suitable, sustainable and significant actions that effectively integrate climate and nutrition into IFAD's investments in Ghana in general (including strategies, processes and/or methodologies if appropriate). Which are also capable of enriching IFAD's project designs with climate-nutrition linkages.
- To suggest feasible and concrete actions that can then be incorporated into the full design of PROSPER and flesh it out further.
- To conduct further literature review on approximately 5 pathways with actions selected by the Design Team. These will contain clear linkages to PROSPER's target groups and will explore possible synergies with ongoing projects such as GASIP, REP and AAFORD.
- To conduct field visits (if the situation allows) to understand the present living conditions of the rural poor and other IFAD target groups (by local consultants).
- To validate the findings from the study mission in a national level stakeholder workshop (digital) to learn from each other and build consensus.
- To support the Design Team on challenges related to the integration of climate and nutrition into project design which could be beneficial for the overall project goal and development outcome.
- To identify strategies that favour marginalised sub-sections of the population as main recipient of the interventions.

The mission team will:

Deliverables:

8. The mission deliverables include:
    a. A pre-design study mission Report for Ghana with an integrated climate nutrition analysis; the document also describes the stakeholder landscape, potential COVID-19 implications, possible pathways and opportunities to effectively integrate climate mitigation, adaptation and nutrition, which are validated by the stakeholders; the report includes feasible and concrete potential interventions for consideration for the PROSPER project in Ghana.

    b. A remote (power point) presentation to be presented during the briefing meeting with the design team.

    c. A multi-sectoral stakeholder consultation workshop to discuss the preliminary findings in Ghana with the objective to (i) validate the recommendations and interventions proposed (ii) receive additional input and ideas for the pathway development (iii) and to create awareness on integrated approaches and linkages between the mainstreaming themes of key stakeholders.

Participants will involve different sectors such as agriculture, environment and climate, health and nutrition, gender and youth among others; they will include representatives from the government agencies, UN, NGOs, research organisations, private sectors**.**

d. A summary of the main report which will extract from it the main points on the following:
   i) Key lessons learned (2-3 paragraphs)
   ii) Situation analysis: Summary nutrition landscape and analysis of the nutrition situation the country; the main nutrition problems; policies and strategies to address nutrition-related challenges in the country; drivers of malnutrition and the specific groups affected in the project areas, proposed pathways for climate-nutrition integration in the PROSPER design for reaching the identified groups (4-5 paragraphs)
   iii) Menu of key activities (under different pathways) for consideration in the PROSPER PDR. Each activity has to be supported with the unit cost.
   iv) Implementation arrangements: Suggested mechanisms to reach the different activities to the relevant groups (draft suggestions for consideration during the design mission) (1-2 paragraphs)
   v) Partnerships: Summary of PROSPER's partnership opportunities with national and regional projects/programmes (if possible provide the details of contact persons who can be approach during the design) (1 paragraph)
   vi) Summary of Key risks and mitigation measures (1-2 points)
   vii) Key M&E indicators, KM and communication suggestions (1 paragraph)

Mission members:

9. Internationals in the Netherlands
   - Ilse Hennemann, Advisor Environmental Governance & Climate Change, WCDI
   - Sanne Bakker, Advisor Food and Nutrition Security, WCDI

10. Local consultants
   - TBD

11. IFAD

Please insert

Counterpart Ghana: Ministry of Food and Agriculture (MoFA)
Duration of the mission:

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Report WCDI-21-163

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