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Improving Income Security through Vegetable Production from MDG1c Intervention Sites of Upper River Region in the Gambia

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Abstract
Agriculture contributes immensely to the socio-economic development of smallholder farmers as it provides food, nutritional and income for women and youths whose livelihood activities are centered on crops and livestock production and marketing. In the Gambia, agriculture is mainly rain-fed with fragmented land holdings in the rural communities. This research finding was conducted in two (2) vegetable schemes of Dampha Kunda and Darsilameh respectively. The objective of this study was to evaluate the yield capacity and income security of women vegetable producers in the Upper River Region of the Gambia. The sampling method was non-probability using the purposive sampling method based on field observation and experience. The result in Table 1, shows that a total yield of 5,914 kg was scored with a total income of 4,139,800 from onion production. In addition, the result in Table 4, indicates that the highest yield was 45,000 kg/ha while the least yield was 26,000 kg/ha with an average yield of 30.6kg/bed. In conclusion, the application of best agricultural practices, capacity building, and utilization of appropriate agricultural technologies enhances the yield and income of vegetable producers in rural communities. This would go a long way in improving the lives and livelihood of women producers, provided the women farmers continue to adapt and apply the best agricultural technologies.

Keywords: Income security, vegetable, production, MDG1c, intervention

1. Introduction
Agriculture plays and will continue to play a significant role in the socio-economic development of developed and developing countries as the main provider of food and income of rural households whose livelihood activities depends on crops and livestock production. In the Gambia agricultural production is mainly rain fed, with fragmented land holdings of smallholder farmers. It is characterized by low input, use of inappropriate agricultural technologies which results to low yields, and only about 50% of the arable land is being cultivated. Agriculture is the main source of income for about 72% of the extremely poor rural households. There is room for improvement by increasing productivity per unit area under cultivation. In the wake of increasing production and income security of small holder farmers across the country, the EU-FAO in collaboration with the Gambia government deem it necessary to intervene in assisting the women and youth to improve on their lives and livelihood. The MDG1c brought together governments, the international community, civil society and the private sector to achieve concrete goals for development and poverty eradication. The issue of income security is not only concerned of having an adequate level of income but relates to assurance and expectation of receiving an income today and the future (Schreinemachers et al. 2018). Agriculture contributes to MDG1c through agriculture-led economic growth and improved nutrition.

In low income countries economic growth in which The Gambia is not exceptional enables increased employment and rising wages, as the only means by which the poor will satisfy their needs sustainably.

Furthermore, income security is actually perceived and expected returns which can be worried but this is real for aged producers in the rural communities of the Gambia. Hence, their opportunity and ability to generate additional income can be significantly reduced and in many cases non-existent (Mukaila et al, 2022b). This resulted to the unfolding of MDG1c project sponsored by European Union through Food and Agriculture Organization. Importantly, Upper River Region is amongst the regions predominantly known for its participation in agricultural activities ranging from crops and livestock production as source of income to improve on their lives and livelihood. The objective of this study was to evaluate the yield capacity and income security of women vegetable producers in Upper River Region of the Gambia. Ultimately, with the intervention of MDG1c in this region has come at a better time where smallholder farmers faced serious production constraint relegating their yield potentials over the years.

Primarily, MDG1c was formulated with the view of assisting smallholder farmers and small-scale food processors to add-value to improve on production, processing and marketing techniques in order to attain food security, reduce poverty and increase income through the provision of production inputs (seeds and fertilizer) and capacity building. The food security policy will enhance domestic production particularly nutritious and safe food, improved access through the promotion of viable farm and off-farm income generating activities by enhancing stability of supplies through effective processing, storage and food reserve mechanisms. According to empirical studies, to attain food security there must be enough provision and judicious use of fertilizer on marginal soils (Abdulai and Huffiman, 2005). Vegetables do not serve as means of livelihood to farmers but to many intermediaries such as wholesalers, retailers and farm agents who participate in the value chain approach moving food commodities from downstream to up-stream. Thus, vegetable production has a great potential to curb the problem of malnutrition, high poverty rate and income insecurity among rural people (Mukaila et al. 2021a). Thus there is need to examine whether vegetable production has improved the income, livelihood and living standard of vegetable producers. This will allow policymakers to design policies that would have an impact on promoting vegetable production in a wake of improving rural income.

According to (Imathiu, 2021) income security is important for socio-economic development of a society and enhances local economy. The women and youth producers who usually secure income will safe guard the income to solve their domestic engagements at household level while reducing poverty at community level. In addition, secured income facilitates women producers to contribute to the economy. Importantly, an individual level, income security greatly enhances everyone's ability to have a dignify and quality life. (Ayodele et al. 2021) engaging in vegetable production by rural households can play a significant role in alleviating poverty, improve food and nutritional status, and income security. Furthermore, climate change and its related issue affects the production and productivity of crops and livestock production in which vegetable production is an integral part of the food systems. Agriculture is a victim of climate change but also a major part of the climate change problem and with dwindling natural resources, sustainability of the food system is important (Najera, et al.2018). Responsible consumers would like to buy fruits and vegetables that have been raised in a sustainable manner, and many retail and food service entities would respond to demand and supply forces. In addition, the women producers in the project interventions sites practices sustainable production systems such as compost making, mulching, integrated pest management and better health soil management to improve on yield and income of youths and women. The Smallholder farmers do still use chemical fertilizers but many farmers within the project areas are now increasingly apply compost despite the challenges of providing sufficient materials to cover an entire farm at ago. In the long run, there is a trend towards elimination of chemical fertilizers as farm areas treated with compost or manure do not need to be fertilized in years to come by women and youths (Chen F, Song, y. and Li, X. 2019). The appropriate mechanism of sustainable food system is the promotion of climate-smart agriculture is a priority concern for smallholder farmers. There is a range of agricultural management solutions, which can improve crop productivity, enhance resilience to climate shocks and reduce carbon emissions. Importantly, women vegetable producers understand that diversifying their activities will make their vegetable gardens more resilient to climate change while increasing productivity and improving the overall quality of their soil health. Inclusiveness is a strength of the climate-smart where women, youths, researchers, extension workers and other partners come together to test a range of options in an integrated approach to project intervention sites. The women and youths involve in vegetable production are seriously challenged with easy access to finance to start their on-farm and off-farm activities. Often their own financial reserves are small and they need access to appropriate credit facilities to keep their businesses on track.

Furthermore, women vegetable producers also have the culture of saving part of their incomes to micro-financial institutions. A new approach is to analyzed the bottlenecks in production and marketing attract producers to added value to their products and activities along the value chain approach. Once agricultural products are ready for market, farmers, traders and other rural entrepreneurs may consider processing them to increase their market value (Yu, et al. 2020). The rural finance has an important role to play in this process as it can provide the funds needed to pay for inputs and cost of production, processing and marketing. Successful, farmers and other rural entrepreneurs will be able to improve their living conditions, rural income improve, demand for household need by women to increase their financial obligations at community level (Najera, et al.2018). According to (Maritine, et al. 2020) the issue of climate-smart approaches through vegetable production have improved food security, resilience, and adaptation given women and youths options for adapting climate change measures in their vegetable gardens. Any significant fluctuation or change in the region's climate (especially in terms of temperature and rainfall) could have significant adverse effects on the agriculture sector, including a general reduction. However, climate change issues impacted negatively on availability of readily available markets reducing the income level of smallholder farmers.

Materials and Methods

The research methodology is a guiding process of data collection at field level ensuring reliable, and valid data are collected to address the research objectives. The process involves how and where data is collected, analyzed and interpreted. The sample and sampling method was non-probability sampling using the purposive method of data collection based on field observation and experience The process of data collection was done in consultation with the extension workers with the vegetable producers in two (2) vegetable schemes of Dampha Kunda in Tumana District and Darsilameh in Sandu District respectively. The data collection processes and procedures was mainly on focus group discussion through interaction with women vegetable producers. The data collection focuses mainly on *yield, price and income*, and the variables were non-parametric and parametric. A statistical tool of SPSS was used for analysis and interpretation of the results from the data collected. Map of the Gambia marked in red colour indicates the interventions sites of MDG1c project.

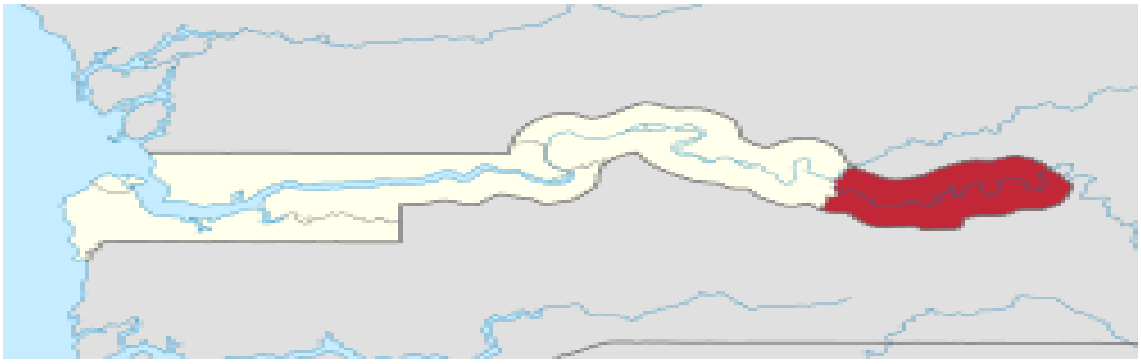

Fig 1: Shows the project intervention sites

Results and Discussion

The government of Gambia and other development institutions has given esteem priority to the promotion and development of horticulture sub-sector. The government will continue to make frantic effort to boost the sector by designing agricultural policies and programmes tailored to improve on the livelihood of less privilege farmers such as the youth and women. The MDG1c project has created conducive production environment by providing modern irrigation facilities such as bore-holes, solar panels, reservoirs, fencing materials, overhead tank and provision of seeds, fertilizer and simple garden tools. However, these were the outstanding problems that really affects vegetable production and productivity in many rural communities of the Gambia where FAO-MDG1c intervened to solve some of the daunting challenges. The result tables from the 2 (two) schemes of Dampha Kunda and Darsilameh shows that, onion production has been given surmounting priority because of its comparative advantage on other vegetable crops. The result in Table 1, shows that a total yield of 5,914 kg scored a total income of D4,139,800 from onion production. The demand for onion always excel, because it is consumed on a daily basis as additives to food sauce or any other food menu (Sing et al.2021). Furthermore, onion has become a prominent variety accepted by women farmers in the rural communities as a results of high rate of income. Vegetable farming has been ongoing for decades in many countries as means of job creation, poverty reduction, and income generation for the growing number of women producers particularly dry season vegetable production (Mukaila et al., 2021b). The rate of returns from all the vegetables grown by producers is quiet reasonable and it will enable the producers to solve their household engagements on a sustainable manner. Therefore, horticulture sub-sector has high premium to create job opportunities, ensuring increase food security, nutrition and export diversification, poverty reduction and economic growth particularly the vulnerable groups or associations.

Table 1: Shows yield data on dry season production for Dampha Kunda

Crops	# of bed ($5m^2$)	Yield/ha (kg)	Average yield (kg)	Total yield (kg)	Price/25kg (Dalasi)	Income (Dalasi)	Income (US$)
Onion	327	967	18	5,914	700.00	4,139,800.00	70,166.10
Cabbage	193	338	18	3,502	1000.00	3,502,000.00	59,355.93
Egg plant	154	109	9.1	1,410	700.00	84,600.00	1,433.89
Bitter tomato	295	198	4.5	1,341	700.00	93,870.00	1,591.01
Okra	260	182	5.3	1,398	1000.00	1,398,000.00	23,694.91
Pepper	98	17	3.4	341	1,200.00	409,200.00	6,935.59

The production and marketing of vegetables in the rural communities of Upper River Region will continue to serve as good source of income to producers, thus improving the lives and livelihood of women farmers through the support of agricultural policy and programmes. The result in table 2, Darsilameh producers indicates that, cabbage scored a total yield of 6,349kg with the total amount of D6,349,000.00 while the least amount earned was D2,766,000 from bell pepper. In comparison, different schemes have their own comparative advantage of vegetable production. The analysis shows that onion and cabbage has more returns for Dampha Kunda and Darsilameh respectively. Furthermore, there is slight difference of prices because the producers send their commodities to same central market or local markets where competition is high among consumers (FAO, 2020). Market-oriented production is the best approach if farmers would adapt the best practices and apply the knowledge and skills to obtain better yield. Vegetable production is one of the most potential windows of opportunity for income generation targeting the consumers on time, set better price and supply

quality produce to achieve better returns (Poudel, 2020). In order to be effective, farmers and their organizations need to be actors in the initiatives and projects that concern them, working closely with development actors.

Table 2: Shows yield data on dry season production for Darsilameh garden

Crop	# of beds (5m x5m$^{2)}$	Yield/ha (kg)	Average yield/ bed (kg)	Total Yield (kg)	Price/25kg (Dalasi)	Income earned (Dalasi)	Income Earned (US$)
Onion	917	7,390	17	15,942	700	1,115,940.00	18,914.23
Cabbage	318	1,009	19	6,349	1000	6,349,000.00	107,610.16
Egg plant	334	200	4.4	1,481	600	88,860.00	1506.10
Bitter tomato	309	196	4.1	1,296	700	90,720.00	1,537.62
Okra	335	288	5.1	1,719	1000	1,719,000.00	29,135.59
Big pepper	342	394	6.7	2,305	1,200	2,766,000	46,881.35

Primarily, the pattern of vegetable production has taken a new dimension of crop diversification through the adoption and application of best agricultural practice techniques. The pattern of crop diversification is processing of producing crops in form of sequence or rotation by portioning the land area into different blocks, Primarily, FAO-MDG1c developed an innovation of market plan by stemming out block design method of vegetable production. The result in table 3, shows that, block A, which was onion registered a total income of 17,719,200.00 with a total yield of 25,596kg from 2.1ha block while the lowest income earned was block B with a total of D1,020,180.00. The lowest yield registered was okra production but scored highest income meaning that, it has more comparative advantage over onion, bitter tomato and cabbage respectively. Income is an important indicator used to establish the living standard of farmers and thus a measure of poverty alleviation among rural farmers (Marzieh and Eric, 2023). The implication of this high returns was as a result of market forces which is demand and supply The block design or production pattern really helped the women producers to over-come their challenges of pests and diseases invasion, better yields, market glut, management practices, diversification, and better income (Rai et al.2019). The application of this design had adequately solved the problems of market and marketing issues because consumers demand different fruits and vegetables in a specific market location thus reducing market glut at the peak of the season (World Bank, 2018). Onion is widely grown by women and youth farmers having comparative advantage on other crops because every household in the Gambia consumed onion directly or indirectly. Ultimately obtaining better yield is anchored on performance, by practicing best agricultural technologies on local variations within fields to adapt the use of fertilizers, seeds, crop nutrients, plant protection, and better soil management practices.

Table 3: Production pattern and income data

Vegetable crops	Cultivable area (ha)	# of beds (1 x10m^2)	Total yield (kg)	Income earned (Dalasi)	Income earned (US$)
Onion (A)	2.1	948	25,596	17,917,200.00	303,681.35
Bitter tomato (B)	0.6	347	14,574	1,020,180.00	17,291.18
Cabbage (C)	0.6	320	15,040	1,504,000,00	25,491.52
Okra (D)	0.6	330	3,238	2,266,600.00	38,416.95

The farmer field school concept simply described more of field participatory learning where smallholder farmers meet regularly in their own demonstration filed to exchange knowledge and share experiences, in a better way of achieving sustainable agricultural production to improve on quality life. It allows teaching of improved production technologies which includes crop management measures and post-harvest practices to enhance market access (World Bank,2019). Importantly, in field-based setting, farmers were able to investigate a wide range of topics, such as soil fertility management and water resources management; compost making, bio-pesticide formulation, marketing skills; and diversification of farming systems for better income generation (Akambi et al. 2020). The process of learning-by-doing promotes local based experimentation, group management and decision-making where farmers eventually "own" and adapt improved practices (Asadu et al. 2018). The result in table 4, indicates that, the highest yield (kg)/ha was 45,000 while the least yield (kg)/ha was 26,000 with an average yield of 30.6kg/bed (kg). The differences in yield data by women producers was as a result of good farm management practices of timely application of fertilizer, weeding, watering and other related field operations. (Manu et al.2019). Furthermore, women and youths obtained income from vegetable production which implies that income generation is largely dependent on agriculture. Income can be obtained from off-farm business activities or petty-training in order to make ends meet.

Table 4: Farmer field school yield data of Dampha Kunda vegetable garden

Crop 1	# of beds cultivated (1 x10m^2) 2	Total area cultivated (ha) 3	Total Production (kg) 4	Yield (kg)/ha 5	Average yield/bed (kg) 6
Onion producers	(1x10m^2)	0.001	26	26,000	30.6
	(1x10m^2)	0.001	26	26,000	
	(1x10m^2)	0.001	25	25,000	
	(1x10m^2)	0.001	32	32,000	
	(1x10m^2)	0.001	38	38,000	
	(1x10m^2)	0.001	31	31,000	
	(1x10m^2)	0.001	34	34,000	
	(1x10m^2)	0.001	32	32,000	
	(1x10m^2)	0.001	45	45,000	
	(1x10m^2)	0.001	27	27,000	
	(1x10m^2)	0.001	27	27,000	
	(1x10m^2)	0.001	32	32,000	
	(1x10m^2)	0.0006	22	22,000	

The farmer field school is an extension tool or approach without walls use for dissemination of new agricultural technologies to farmers particularly women and youths. The extension system is widely using the farmer field school concept in vegetable gardens, in a practical orientation of learning by doing, seeing and feeling. The Farmer Field School in Darsilameh was designed to conduct local based research on onion through adaptive research. The application of best practices was more of participatory research techniques resulting to better understanding of the priority needs, availability of resources and activities of women producers (Maritine, et al. 2020). The result table in 5, shows that, 30,000 yield kg/ha was harvested with an average yield of 26.2kg/bed (kg). In comparison, there is much significant difference of average yield data of 30.6 and 26.2kg between Dampha Kunda and Darsilameh farmer field school respectively. According to (Tsiboe et al, 2019) involving farmers to develop their own local base research capacity through indigenous local knowledge system at farm level in tandem with modern research can also contribute immensely to the economy growth of rural communities. The innovative idea of harnessing women's wide-range of knowledge and skills to attain sustainability and nutritional value of vegetables is paramount to vegetable production. The risk of crop failure was as a result of producing single crop but the scenario was totally different for women engaged in vegetable production as climate smart agriculture being practice by smallholder farmers (Anna and Helene, 2014) Furthermore, according to farmer field school concept would enable farmers to learn and improve their knowledge, change attitude and enhance their skills needs for commercialization while working on their own gardens.

Table 5: Farmer field school yield data of Darsilameh vegetable garden

Crop 1	# of beds cultivated (1 x10m^2) 2	Total area cultivated (ha) 3	Total Production (kg) 4	Yield kg/ha 5	Average yield/bed (kg) 6
Onion producers	(1x10m^2)	0.001	26	26,000	26.2
	(1x10m^2)	0.001	28	28,000	
	(1x10m^2)	0.001	30	30,000	
	(1x10m^2)	0.001	29	29,000	
	(1x10m^2)	0.001	29	29,000	
	(1x10m^2)	0.001	24	24,000	
	(1x10m^2)	0.001	22	22,000	
	(1x10m^2)	0.001	22	22,000	

Conclusion and Recommendations

The MDG1c project deems it necessary to target the small holder farmers in order to achieve its laudable objectives. The small holder farmers particularly women were very instrumental in attaining income security as they produce kilograms of vegetables. In the context of attaining food and income security, cultivable land is important to producers' particularly vegetable growers. Importantly, the issue of capacity building in area of technological and management skills of record keeping, entrepreneurship, group management and leadership, profit and loss, savings, knowledge utilization, capital investment and diversity of activities were nurtured ensuring sustainability. In conclusion, application of best agricultural practices, capacity building and utilization of improved seeds and fertilizers have enhanced the yield and income of vegetable producers in the rural communities. This would go a long way in improving the lives and livelihood of women producers, provided women farmers would continue to adapt and apply the best agricultural practices from field workers.

The research findings also came up with three (3) areas of recommendations (1) Implications for future intervention, were development partners need to open flood gates to other communities who have never benefitted from any project support, (2) Implications for policy and practice in which development partners and government to formulate workable policies and programmes that would address the problem of access to markets, low yields and finance to women farmers. Hence, policies are directed to address priority needs of smallholder farmers in order bring change in their livelihood for better living standard and (3) Implications for farmer based organizations that is, a better organized producer groups or cooperatives would be in a position to produce commodities both in quantities and qualities thus increasing food and income security. In addition, development projects need to allow farmer groups to fully participate in decision

making process from scooping, planning, implementation, monitoring and controlling of injected resources. Finally, the formation of an umbrella cooperatives would assist groups to have better markets, create better opportunities and cultivate the idea of savings for the group members on sustainability. Therefore, imperative for the government to develop land reform policies that would allow women producers to have access, rights and ownership of productive land. Importantly, policies can have significant impact on social and economic gain on related goals of livelihood, food security and poverty reduction of onion producers.

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