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Research Article

Embracing Innovative Agricultural Systems and Harvesting Food Insecurity in Rural North West Region of Cameroon

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Abstract: Contemporary market-oriented agricultural innovation has become a fundamental driver of food insecurity in sub-Saharan Africa (SSA). In rural SSA, many small farmers are currently embarking on innovative agricultural systems (IAS), which are not only technically challenging, but food insecurity prone. Progressively, labour input in staple food crop production is dwindling and conversely increasing in the cultivation of income generating crops. SSA boost of no rigorous empirical study on the relationship between market-oriented agriculture and food insecurity. To fill this knowledge gap, this study relied on conceptual insights from scholars, oral histories captured through interviews, informal conversations, focus group discussions, questionnaire administration to 60 households' respondents and field observation to analyze the correlation between unprecedented cultivation of income generating crops and food insecurity in rural North West Cameroon using Binka community as case study. Quantitative data collected were processed and presented in the form of tables and graphics for descriptive analysis while *in-vivo* codes, analytical codes and themes were generated for qualitative data analysis. Results reveal that 73.9% of farmers have embraced IAS though mastery of inputs application, farm maintenance capability, issues of purchasing power and institutional challenges remain critical (62.5%). Over dependence on IAS has engendered food insecurity and kept poverty in perpetuity. Reconciling poverty alleviation and food security in the region advocates for enhancement of subsistence agriculture and farmers training on IAS and techniques.

Keywords: Embracing innovative agriculture, food insecurity, rural poverty, subsistence agriculture, training of small farmers, rural North West Cameroon.

INTRODUCTION

Evolution of Innovative Agriculture from Traditional Farming Systems

With improvements in health facilities and health care in the world, food started becoming scarce to the increasing number of mouths particularly in the developing world (Delgado & Mellor, 1984; World Bank, 2012 and Nwachukwu 2017). There is growing commonality among scholars that the world is facing problems of hunger and rapidly growing populations which Malthus had earlier amplified (Baum, 1986, Kvaloy, 2004) and agricultural scientists began mapping out strategies for quantitative and qualitative food production to satisfy the growing population. Some of the global strategies included Green Revolution between 1950s and the late 1960s in the developing world (Moussa, 2002; Kvaloy, 2004 and CAADP, 2012), which unfortunately was less successful in Africa as the socio-cultural dimensions of food, the level of input affordability and technical know-how in rural Africa were not part of the whole package. It has been submitted that at any stage of technological shift, mainly issues of number of working hours, better tools in terms of labour productivity and farm sizes are considered (Boserup, 1965 and Biswanger & Pingali, 1989). Similarly, Hayami & Ruttan (1971) contended that increasing population densities will induce the shift to progressive labour-intensive farming systems. Factors such as poverty, food acceptability and the level of technology in rural Africa do not match with such proscriptions, which are attuned to commercial agriculture. Green Revolution in Africa, took the form of market-oriented agriculture which in contemporary times, hinges on agricultural

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competitiveness and is no less in magnitude than large-scale commercial agriculture (AfDB, 2019). The laying of emphasis on income generating crops in Cameroon in the form of Second Generation Agriculture (SGA) launched during the agro-pastoral show in Ebolowa by the president of the Republic of Cameroon (Paul Biya) in 2011 is putting the majority of the rural farmers out of steam. Farmers in SSA are smallholders who exploit practically very small parcels of farmland of two hectares or less, representing 80% of all farms (Ngwa, 1989). Over 62% of the population is employed in such farms (Staatz and Dembele 2007, Wiggins 2009, Livingston, Schonberger and Delaney, 2011), and in 2016 smallholder production in SSA generated 17% of GDP and 1,697,468 million of US Dollars in 2018 (Kangethe 2016, World Bank 2019).

Unrealistic impression has been given that IAS can be transposed from one part of the world to another for high productivity, production and food security. Focusing on the relationship between culture and food security (Olum et al., 2017) captured that food security has dimensions which might not be adequately addressed by all global policy approaches. The authors succinctly opined that culture is a strong determinant of food security through its influence on what society considers acceptable for consumption (Olum et al., 2017). The reality of the applicability of market-oriented crops in SSA's agricultural system is grounded on an economic than a household basis, evident in the shift from subsistence farming towards greater intensification (Livingston, Schonberger and Delaney, 2011).

The Missing Link in Agricultural Innovations in Sub Saharan Africa (SSA)

The missing link in agricultural innovations in SSA, stems from the perception of these on-farm innovations. Agricultural innovations take their roots from the theory of innovation diffusion and up to recently, the adaptability of the innovations in space and time remains critical. The origins of the diffusion of innovation theory are varied and span multiple disciplines. Many authors have defined the concept of agriculture innovation according to their perceptions. The (AfDB 2018) conceived it as a transformation that can substantially improve the quality of life of rural farmers in alleviating poverty and enhancing food security through the expansion of agricultural innovative finance while FAO (2018) coined it as a process whereby farmers are introduced to new or existing ideas for the first time in a specific context to increase effectiveness, competitiveness, resilience to shocks or environmental sustainability and thereby contribute to poverty reduction, food security and nutrition enhancement resulting in zero hunger. But AGRA (2018) opined that agriculture innovation is related to the efficiency **and productivity of the small-scale commercial farmer, while** Chauvin, Mulangu and Porto (2012) captured that it is an engine to reduce poverty and improve general wellbeing through better access to nutrients. Unfortunately this is not the case in SSA as small farmers still remain poor and food unsecured (FAO, 2018 and Townsend, 1999). Though FAO (2018) clearly revealed that innovation is central to lifting family farmers out of poverty, it has never been easy to reconcile agricultural employment for youth and rural women and achieving food security and the sustainable development goals. In most of SSA, any moment that emphasis is laid on agricultural competitiveness, food insecurity sets in as observed with the 2008 hunger strike in Cameroon (Berdegué and Escobar, 2012 and Amin, 2013). Small holder commercial agriculture is a major vector that siphons female labour from subsistence agriculture that feeds Africa. In addition, the ability of smallholder farmers in SSA to increase on-farm investments for greater productivity is constrained by their capacity to manage the risk-return trade-offs in moving towards intensified agriculture (Livingston, Schonberger and Delaney, 2011) and remains critical in rendering agriculture in SSA less competitive and the continent, food insecure (AfDB, 2019). This gave a new twist to the High 5s as ongoing institutional and policy frameworks are attuned to radical transformation of Africa's agriculture into a business-oriented and commercially viable instrument (Sahin, 2006 and AfDB, 2019), that unfortunately undermine the subsistence sector which is under the aegis of women who feed the population. Opportunities for economies of scale associated with marketing, have emerged as the driving force behind the diversion of labour force previously used by small farmers for staple cultivation to the income fetching crop sector (Maxwell, 2001; Chauvin, Mulangu and Porto, 2012 and FAO, 2019).

Food Insecurity Nexus in SSA

It has been observed that increasing production and productivity to close the food insecurity gap in SSA, remains challenging. Smallholders need to embrace new agricultural techniques that are incompatible with their purchasing power as they entail greater capital and skilled labour input (AfDB, 2019, FAO, 2018). As noted, pro-poor capital allocation to small farmers in SSA remains critical as the cycle of rural poverty is yet to be broken (FAO, 2019). The provision of new farm technologies seldom matches with the capacities of the farmers to appropriately apply them for efficient and effective poverty reduction, and agricultural production and productivity (FAO, 2006 and Nwachukwu, 2017). Similarly, a greater proportion of their labour force has been diverted to income generating crops with little attention paid to the production of staples which are culturally appropriate to the farmers in SSA. Cultural norms, quite often influence food and nutrition security as well as the quantities of foods consumed and who consumes them (Olum et al., 2017). This cultural dimension of food is an integral part of the High 5s initiative, Feed Africa (AfDB, 2018) as enshrined in the Millennium

Development Goals 1 and 2. Livingston, Schonberger and Delaney (2011) adhered to this opinion and avouched that the increasing interest in market-oriented crops especially by youths is grounded on the view that it provides rural employment opportunities with higher economic returns over traditional staple systems. This dream, however, is challenged by the poor mastery of alien farming techniques and limited capital inputs, which hamper not only agricultural competitiveness in SSA, but also plunge the rural farmers into food insecurity. Rural farmers in SSA have limited access to on-farm investments such as appropriate seeds, fertilizers, irrigation and mechanization technologies and reductions in post-harvest losses (Townsend, 1999).

It has been noted that improvements in agricultural productivity need technological innovations, adoption and application of the technologies Chauvin, Mulangu and Porto (2012). This agricultural innovative euphoria has lured many small rural farmers to embracing techniques and changes that are less responsive to their ecological zones and capabilities with ambivalent and sometimes paradoxical outcomes (FAO 2018). The low productivity of African agriculture is related to the high prevalence of poverty where more than 50 percent of people live on less than USD1.25 per day and more than 223 million people are under-nourished (FAO, IFAD and WFP, 2015 and AfDB, 2018). The number of poor people involved in agriculture is probably a reflection of its importance in reducing poverty and enhancing food security as about 75% of those surviving on less than US$1 a day and with nicety of farm tools and inputs live in rural areas and are dominated by the female folk (IFAD, 2001; Livingston, Schonberger and Delaney, 2011 and FAO, 2018). With the adoption of Agenda 2030 and the Maputu Declaration of 2003 hopes, were high that transformative agriculture in SSA was going to trigger poverty reduction, improved education and health. But several years later, the number of voices raising the issues of poverty and food insecurity in SSA seems to have increased. Where then is the problem, is rural Africa not embracing innovative agricultural systems and harvesting food insecurity?

METHODOLOGY

The North West Region, located in the Western Grassfields of Cameroon, is one of the currently existing ten regions in the country. It lies between longitudes 9˚45′ and 11˚10′E of the Greenwich Meridian and between latitudes 5˚43′ and 7˚9′N of the equator (fig.1). From figure 1, it is noticed that the North West Region is bounded in the north and west by the Federal Republic of Nigeria, in the south by the West and the South West Regions, and in the east, by Adamawa Region (The 2009 administrative map of Cameroon). Rural North West is quite diverse in terms of socio-cultural and ecological potentials. Such diversity is reflected in the various agricultural innovations and the attendant challenges inherent.

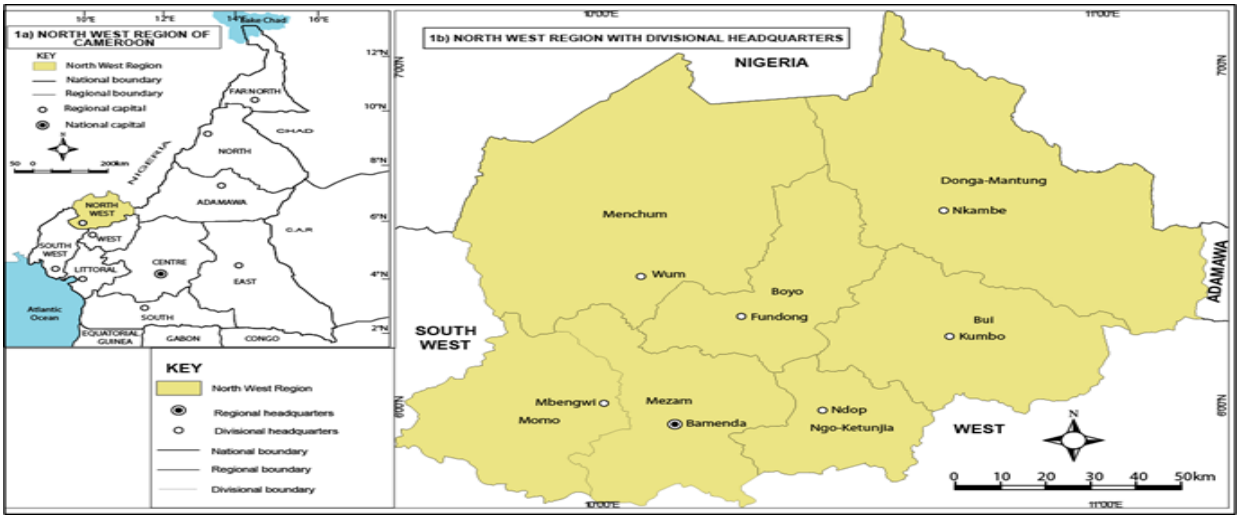


Fig. 1: North West Region in Cameroon and North West Region and headquarters

Source: Adapted from the 2009 administrative map of Cameroon

In order to acquire relevant data for appropriate narratives on ill-adapted innovative agricultural systems in rural North West Region of Cameroon (RNWC), a scoping study was carried out in Binka community in the region. The enquiry was intended to investigate and analyze the correlation between unfamiliar IAS, food security and poverty reduction in SSA using Binka community as a case study. The study was based on qualitative and quantitative data sourcing via a review of related literature, focus group discussions (FGD) and semi-structured interviews for oral histories, and a questionnaire administered to respondents in Binka (Donga-Mantung Division). The euphoria that stimulated these rural farmers to adopt IAS vis-à-vis their production and productivity capabilities, food security and poverty reduction priorities in the rural community influenced the choice of study.

Secondary data were gleaned from data sources such as the internet, textbooks, articles and theses on agricultural innovations, extension services, on-farm incentives, investment capacities and household labour orientation. Population and household information were obtained from BUCREP (*Bureau Central des Recensements et des Etudes de la population*) Yaounde as of the 2005 population and housing census. Both African and country level policy documents related to IAS such as Tropical Agriculture Platform (TAP) on Agricultural Innovation Systems (AIS), Comprehensive African Agriculture Development Programme (CAADP) (2011, 2012), and Second Generation Agriculture (SGA) *Les Atouts Economique du Cameroun* (2012), the High 5s of the AfDB (2019) were consulted. Other sources of literature included UN (2017), FAO (2012, 2018), Nwachukwu (2017), Livingston, Schonberger and Delaney, (2011). To adequately understand the trends of agricultural technology in this area, some evolutionary changes in farming systems were examined.

Primary qualitative data for the study was collected from Binka rural community in the North West Region of Cameroon using semi-interview and FGD guides. The study relied on the premise that farmers will always adjust to potential and substantial innovations that enhance production and productivity for poverty reduction and food security despite cropland scarcity (Hunter & Whitten, 1976, Flannery, 1969, and Nwachukwu, 2017) and limited mastery of envisaged techniques. A questionnaire was administered to a 2% sample of the households through a systematic random sampling procedure with 60 household members responding to it. A total of three FGDs were held. For purposes of gender narratives, one mixed sex FGDs, one female and one male groups were organised with farmers in the community.

In all, 21 participants provided oral histories through FGDs in Binka while 2 resource persons provided additional oral histories through informal discussions. Semi-structured interviews with two local employees of the Ministry of Agriculture and Rural Development (MINADER) complemented the oral histories. Additional information was got through field observation for visual geography. Descriptive tables and graphics were used to present the results. FGDs and interviews targeted information on priority innovative farming systems, challenges of accessing the innovation requirements, financial constraints, level of networking as small farmers and their interactions with the local personnel of MINADER on innovative techniques. Other related issues targeted included gender roles in innovative farming systems, the cultivation of food and cash crops, household food and poverty relieve levels, and the influence of market price on innovative systems in relation to poverty reduction and food security. Field visits and observations in the rural community led to the discovery of innovative practices such as chemical application, improvised irrigation systems, interval planting, storage and processing techniques, and challenges.

Data Processing

The administered copies of questionnaire in the rural community were processed by weighting each option selected, one point. Oral histories on IAS from semi-structured interview and FGDs were processed based on the *in-vivo* approach as described by Strauss (1987) and Cope (2003) where the words of the informants were used for open coding and theme building. Unanimously agreed oral histories from FGDs were compared with the findings of AfDB, FAO, the Comprehensive Africa Agriculture Development Programme (CAADP) and other scholars. The comparison was intended to identify gaps in the data set between theoretical adoption of IAS by rural farmers and their capabilities to practise such innovations in SSA (Nwachukwu**, 2017 and** FAO, 2018). Other aspects that guided the choice of themes were small farmer responsiveness to IA, food security and poverty reduction as captured by the AfDB (2019) within the framework of High 5s, Agenda 2030 and Agenda 2063 in the light of the sustainable development goals (SDGs). This data processing phase, paved the way for results presentation and discussion.

RESULTS AND DISCUSSION

The investigation on the relationship between market-oriented agriculture and food insecurity in RNWRC has a number of revelations which up to now have been clouded by the euphoria for foreign earnings and agricultural competitiveness. Response score of 73.9% was in favour of adopted IAS but a majority of the respondents (62.5%) acknowledged poor mastery of the techniques accompanying the innovations (table 1). These findings were corroborated by existing literature. Despite anxiety of small farmers in SSA to uphold their land steward character, many of the proposed agricultural innovative systems are paradoxically less associated with both their technical know-how and their affordability capabilities (AfDB, 2019).

Table 1: Agricultural innovative techniques used by farmers in Rural North West Region

Innovative techniques used / Technique type	Using innovative agricultural techniques in RNWR				Reasons for not using innovative techniques in RNWR					
	Yes		No		Expensive to acquire		Less mastery of techniques		No idea	
	N°	%	N°	%	N°	%	N°	%	N°	%
Interval planting	40	66.7	20	33.3	-	-	51	85	9	15
Fertilizer application	51	85	9	15	16	26.7	38	63.3	6	10
Agro-chemical usage	49	81.7	11	18.3	24	40	32	53.3	4	6.7
Value addition	42	70	18	30	28	46.7	30	50	2	3.3
Irrigation principles	38	63.3	22	36.7	22	36.7	35	58.3	3	5
Cultivation techniques	46	76.7	14	23.3	20	33.3	39	65	1	1.7
Total	266	73,9	80	26.1	110	30.5	225	62.5	25	7

Source: Field survey 2014-2016

Although innovations in agriculture have proven to be essential prerequisites for increasing farm output, most rural farmers in RNWRC are bogged down by their application modalities and insufficient capital to purchase farm inputs. According to oral histories, many farmers in RNWRC adopted myriads of new farming techniques, reminiscent of commercial agriculture. But that euphoria was soon dampened due to little mastery of the working principles of the technologies. For instance, planting intervals involving measurements of planting distances between each crop on the same ridge have been very challenging to the small farmer, informants noted. In addition, interviewees intimated that, chemical usage for value addition and crop maintenance as well as irrigation practices fell outside the realm of the small farmers. In their opinion, set out intervals for grains, tubers and vegetables, among others, which work well for monocropping practices, were not well mastered by rural farmers, though intuitively, they were aware of the effects of crop density on crop performance as reported by a maize cultivator. As observed on table 1, over 66.7% of the respondents acknowledged inappropriate application of these planting specifications by the small farmer in RNWRC. Justifying this assertion, 85% of the respondents associated this inappropriate application with limited mastery of the techniques and the use of improvised tools such as ropes instead of measuring tapes and pecks for the few who even attempted. Oral histories corroborated this assertion and expounded that farmers considered crop spacing measurements time wasting, strenuous and costly, particularly as pecks are difficult to get in the Western Grassfields where the study site is found. Oral histories from interviewees and an extension worker revealed that most of the farmers have limited levels of education and cannot adequately adopt and adapt to the specificities. The extension worker further added that in order to save time, the farmers apply mixed cropping which is a precautionary measure against crop failure and at the same time serves to maximise crop variety. From field observations, crop densification resulted in unhealthy crops, a view previously held by Nwachukwu Jude Uwaoma who admitted that intercropping is more of a harm than good to rural farmers (Nwachukwu, 2017).

Though a high proportion of farmers, 85% and 81.7% are involved in fertilizers application and in agro-chemical usage, 63.3% and 53.3% of them respectively are bogged down by poor mastery of technique application as depicted on table 1. Oral histories acknowledged that the farmers neither have a mastery of which fertilizer and agro-chemical product is appropriate nor to what soil and crop type, and when to apply them remains critical. The wrong choices, timing and application of the products have caused these farmers to apply them on trial basis. In their view, carrying out soil analysis to investigate soil nutrient deficiencies is less important and expensive. The quantities of these products applied are only estimated and such applications often led to counter production and discouragement, they noted. Oral histories from interviewees revealed that many farmers adopting herbicides, insecticides and pesticides for crop/farm management still use wrong weed discriminatory herbicides. For instance, Gramozone which is an appropriate herbicide for coffee farms, is at times used for weeding farms for other crops such as tomatoes and maize with counterproductive results. According to oral histories, extension workers visit only big farmers in their homes and not even in their farms. Such discriminatory practice disfavours the small farmer who is the breadwinner for rural households and needs the services of the extension worker most. During an interview with an extension worker, it was revealed that rendering services to farmers was very challenging and they relied on farmers to fuel the motor bikes which were provided to them, an issue that was out of the reach of the small farmer. This institutional weakness renders the small farmers vulnerable to paltry harvests, post-harvest losses and food insecurity emanating from inadequate acquisition of crop/farm management techniques. In addition, the small farmers find themselves at crossroads due to the abandonment of their previously mastered eco-friendly farming practices and the adoption of innovative agricultural systems, which they have limited know-how. The embedded environmental resilience view in the abandonment of eco-friendly farming practices is shared by many agricultural scientists who now believe that modern agriculture is a driver of contemporary environmental crisis (Altieri, & Rosset, 1995). Besides, there is a

growing appreciation of the severity of the negative impacts of innovative farming systems on traditional cropping systems practiced by rural farmers in this community.

A prime objective of IAS is for massive production, a view which is in consonant with the spirit of second generation agriculture launched in Cameroon in 2011. A major limitation of this approach is that issues of handling, preserving and storing subsequent harvests remain crucial at the level of small farmers in RNWRC. FGD participants were unanimous that inadequate on-farm and off-farm infrastructures for storage and evacuation respectively are among the main sources of discouragement and demotivation to invest in farming for greater output. They expounded that most often, part of the harvest is stranded in farms in cases of good harvests. Findings elsewhere corroborate the difficulties the absence of transport and post-harvest storage infrastructure pose to farmers in RNWRC (Frederick Were-Higenyi, 2010 and Njara 2017). FAO (2012) opined that the level of agricultural infrastructure development in SSA is still low when compared with other regions of the world; a big hindrance to agricultural production and productivity to ensure food security. The absence of storage facilities and post-harvest washing and cooling infrastructure for vegetables have further aggravated the situation as a greater quantity of the produce is perishable. As table 1 depicts, 70% of the farmers carry out value addition (processing and distribution), 46.7% of them acknowledged that the processes are expensive to run while 50% reported that they do not master the transformation of basic farm produce. During a FGD, participants held that high humidity in the area leads to dampness and facilitates crop rot, particularly as most of the cereals and tubers produced are not transformed due to the absence of appropriate transformation tools and the required expertise following low levels of education.

The implementation of soil water enhancement techniques in the area is progressively gaining impetus as various methods are adopted and developed. It was observed that farmers are gradually shifting from streams and rivers-dependent irrigation water to on-farm well irrigation water. Contour bunds, locally adapted sprinklers and the motorised water pumps are also on the rise. With a high proportion of 63.3% of them being involved in improvised sprinklers and pressure motorised pumps, 36.7% find it difficult to acquire the necessary incentives for an efficient irrigation scheme while 58.3% as depicted on table 1, acknowledged that they do not have the financial capacity and mastery in developing and operating such schemes. Oral histories revealed that the rugged nature of the terrain is a major impediment to developing such schemes. The schemes are expensive in terms of purchasing and running costs and the farmers are inefficient in their irrigation techniques which often lead to in-farm soil erosion (plate 1). Pipes and water storage devices such as tanks and troughs are expensive to obtain and even if they are provided, maintenance remains challenging.

Photo 1: uncontrolled conduit resulting in continuous water flow leading to soil erosion (A) and gullies

Photo 2: tapped water in pipes (B) from the slopes through the forest into the farms

FGD participants pointed out that the general inadequate irrigation infrastructure is compounded by climatic variability which impacts negatively on streams, rivers and even farm reservoirs. An agricultural personnel in the field explained that water scarcity associated with climatic variability and farmers inability to generate on-farm irrigation schemes and the use of water pumping power-driven machines, have been supplemented with drip irrigation to minimise the available water. Field observation revealed that rural farmers were generally inclined to adopting irrigation techniques, but the efforts were imperilled by poverty and inaccessible roads to purchase and transport irrigation requirements such as drip-sets and pipes from the market to the farms.

The farmers in RNWRC are evolving alongside innovative cultivation techniques. The mass tilling technique is replaced by the ridging technique based on animal traction and tractors. Table 1 shows that 76.6% of farmers adopted the techniques but 33.3% of them attested their expensiveness while 65% of them has no mastery of them. In 1984, PAFSAT (Promotion of Adapted Farming System based on Animal Traction) was introduced in the area for efficient work but farmers were unable to afford for the plough and the ox and even a tractor that was offered a farming group was not used for lack of operating knowledge as gathered from the field. The introduction of modern innovative tools by State agencies aimed at reducing time-labour

did not consider the capabilities of the small farmers in terms of use. Oral histories attest that farmlands are fragmented due to the land tenure system common in the study site with many them found on hilly terrains rendering the use of tractors inefficient. Besides, innovative practices work well with registered groups, an approach that is uncommon with the small farmers.

In addition, the increasing over dependence on the cultivation of market-oriented crops among farmers in Binka was necessitated by the economic crisis of the 1980s which led to a fall in coffee and cocoa prices in the world commodity market. This, however, caused a shift from coffee cultivation as a household income earner towards food crop cultivation for the same purpose. As gathered from FGDs, the adoption and cultivation of food crops for cash income was one of the many ways to avert the looming financial danger faced in households. The income generated is directed to other household exigencies such as children's education, and the construction of houses with limited focus on household food security. Besides, crops cultivated for the market are mostly hybridised species which do not suit the traditional feeding habits of the rural population as captured through informant discussions. Similarly, Olum et al., (2017) admitted that food has a cultural dimension. It is obviously in this perspective that Chauvin, Mulangu and Porto (2012) captured that culturally, African communitarian feeding values are not in consonant with the income generating crops on which contemporary agricultural innovations are based. Agronomic research in SSA, focuses more on what will be exported for poverty alleviation, but cultivating non-staples in Africa will hardly bring food security to fruition in the continent, the scholars noted.

Common traditional crops cultivated in the past include cereals (*Ngona* and *Coca* white, *Mambila* and millet) while millet is completely abandoned by farmers for its less economic returns. Tubers include (cassava with a maturation period of one year, traditional carrot (*ngwee*), irish/sweet potatoes, colocasia) among others. Vegetables were mainly huckleberry, okra, Chinese cabbage (*kaplar*), beans, and many others. Plantain/banana especially the *achu* banana and the *bakweri* species were common. With time, research institute such as IRAD (Agricultural Institute for Research Developments) introduced new species of plantain such as Giant and Medium French species and legumes (carrots, cabbage, leaks, water melon, beetroots, and tomatoes among others). More than 10 new species of Irish potatoes are now available in the study area, but which are for economic motives (table 2) and not attuned to their socio-cultural food values.

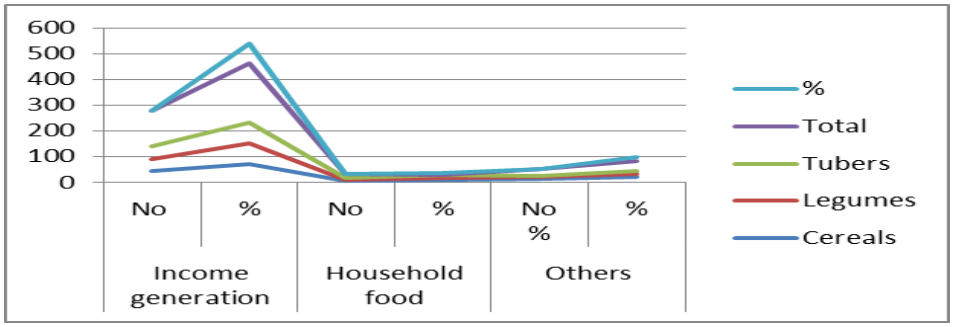
Table 2: Types of crops cultivated and motive for cultivation by farmers in RNWRC

Motive / Crop type	Income generation		Household food		Others	
	No	%	No	%	No	%
Cereals	42	70	6	10	12	20
Legumes	49	81.7	4	6.67	7	11.67
Tubers	48	80	6	10	6	10
Total	139	231.7	16	26,67	25	41.67
%		77.2		8.9		13.9

Source: Field survey 2014-2016

Significant attention has been given to tubers, especially of irish potato (*solanum tuberosum*) of high yielding species such as *Bamira, Tubira, Pamena, Atlas, Copira, Spunta, Manon, Cipira,* all of short cycle maturation (90 days). The famous *Madam* that emanated after the Lady anthropologists, P.M. Kaberry Mbenkum and Fisiy, (1992) cited by Enchaw, (2009) and as identified in the field, have been abandoned by farmers because of its low productivity. The high productivity rooted in these hybridised species is the main driver for its adoption by farmers, 80% for income generation and only 10% for household food security as table 2 depicts.

Oral histories revealed that irish potatoes have a high and rapid income generation potential over yams (*Dioscera Cayanesis*) and cassava. Informants alleged yams were introduced in the 1970s in Binka by migrant farmers with the white species *Dioscera celeta* originating from Nigeria. Apart from potatoes and yams, there was the introduction of the new and improved species such as the Tropical Manioc Selection^2 (TMS^2) varieties of the International Institute of Tropical Agriculture (IITA) with increasing agricultural technology which has transformed cassava status from that of a low-yielding and famine-reserve to a high-yielding income earner for rural farmers as captured in an interview with a field agent. The high economic returns embedded in these crops have tilted farmers' attention towards commercial than subsistence farming. This phenomenon, however, is the main driver to household food insecurity in the study site.



Source: Compiled from table 3

It is shown on table 2 that, 81.7% farmers are involved in vegetables cultivation for income generation as against 6.67% for household food security while 11.6% acknowledged cultivation to handle other family exigencies. Vegetables of high yielding species are huckleberry (*Solanum nigrum*), beetroots (*Beta vulgaris*), celery (*Apium graveolens*), parsley (*Petroselimim crsipum*), lettuce (*Lactuca sativa*), pumpkin (*Cucumbita moschata*), water melon species (*Crimson sweets, Koalack* and *Chaleston grey),* onion (Keystone and Pana), cabbage (*Gromaster, Green colele, Topsic, GSN),* carrot species *Tropical* (long, large), *Amazonia, Royal* (long, large), *Sterk corod,* pepper, groundnuts, garlics, soya beans among others as gathered in the field, are cultivated for income generation. This is indicative of the number of trucks that load these items for urban markets. The economic returns rooted in gardening crops have caused farmers to develop less interest in traditional crops which are less capital-oriented and less productive.

Maize is the main cereal cultivated in the study site. New strains such as (*CASSAI,* Yellow ATP (Acid Tolerant Population), CHC yellow strain, CHC 201, 202, 203 ... *COCA* SR, CHH 101,102,103…, CHH 300 and CR3A of short cycle maturation as against the long cycle Coca white, white *Mambila, and* Ngona strains are still very much appreciated by rural dwellers for their colour, texture and taste, though with regressing production trends of recent. Oral histories revealed that the traditional strains have a long maturation duration of 9months which is not favourable for income generation as against hybridised strains in 3months. Table 2 depicts that 10% of farmers cultivate maize for household food security. This meagre percentage cannot satisfy the food needs of the population. An agricultural extension worker explained that in spite of the fact that hybridised strains are less resistant to environmental conditions of the study site, farmers still prefer them for income generation. The short maturation duration enables them harvest and cultivate other crops such as vegetables which are always in high demands in the urban markets. With agricultural attention tilted towards market gardening-oriented crops which are capital and labour intensive, checks on household food insecurity cannot be substantial as each farmer looks forward to making profits from what was invested. This brings to focus, the need to enhance subsistence farming which is attuned to the cultivation of staple food crops as it was the case in Botswana with the Trust for Okavango Cultural and Development Initiatives (TOCADI) in 2003 (DeMotts, Haller, Hoon & Saum, (2009).

CONCLUSION

Reconciling the adoption of innovative agricultural systems and food security in RNWRC remains critical within a foreseeable time lapse. Increasing tendency towards the adoption of innovative agricultural systems amidst limited technological and financial capabilities of rural farmers for market-oriented crops and institutional lapses account for persisting food insecurity in Binka. The spending of much time and labour on farm operations using crude tools, has seldom yielded the expected production results (Nwachukwu, 2017). Similarly, diverting previously used farmlands for staple cultivation to market-oriented crop cultivation only make matters worse in Binka in terms of food insecurity. Although the adoption of innovative farming systems is essential for achieving food security in most agricultural systems today, innovative farming systems do not necessarily guarantee food security nor do traditional knowledge and systems of crop production necessarily create food insecurity. Adopting innovative farming systems such as the use of tractors, hybridised species and the application of inorganic compounds have their own limitations even in terms of health.

Farmers need to be trained on the diverse agricultural techniques and their capacity built for easy accessibility and affordability of techniques required if innovative agricultural systems that enhance substantial income generation to abate rural poverty, enhance household food security and environmental resilience must succeed. To achieve this, the public sector could direct pro-poor incentives to small farmers, provide on-farm incentives and infrastructures, simple adapted production and transformation tools, agricultural extension services for small farmers and encourage organic farming through institutional regulations.

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