

Impact of Interventions by Consortium for Improving Agriculture-based Livelihoods in Central Africa (CIALCA) on Food and Nutrition Security of Farmer Households

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Abstract—Impact of adopting products promoted by the Consortium for Improving Agriculture-based livelihoods in Central Africa (CIALCA) on food and nutrition security was tested. Multi-stage sampling was used to select 7 project mandate areas, 5 villages/mandate area (stratified into action, satellite and control sites) and 913 households. Structured questionnaires were administered; analysis of impact based on comparison between strata, differences in means tested by ANOVA and significance of difference obtained by Tukey's HSD multiple rank tests. Perception of adequate food sufficiency received a higher rating in action and satellite sites compared to control sites reason being improved agricultural technologies. For >60% of households, worsened food security was due to climatic conditions. Although a higher proportion of households in action and satellite was meeting calorie RDIs in DRC and Burundi the difference was insignificant from control sites. 53% of respondents in control sites indicated a decrease in intake of protein rich foods, this was significantly higher than the proportion in the action (46%) and satellite (41%) sites.

Keywords—Food security, Farmer-households, Nutrition security.

I. INTRODUCTION

HOUSEHOLDS are food secure when they have year-round access to the amount and variety of safe and nutritious foods their members need to lead active and healthy lives. At household level food security refers to the ability to secure adequate food for meeting the dietary needs of all members of the household, either from its own production or through purchases [1]. As simple as this may sound, food and nutrition security remain Africa's most fundamental challenges for human welfare and economic growth [2]. Many people on the continent are unable to acquire and effectively utilize the food they need for a healthy life at all times [2].

In countries like the Democratic Republic of Congo (DRC), Rwanda and Burundi, the past decades were characterized by

political instability, civil conflict, frequent natural disasters (volcano eruptions, droughts), and widespread poverty. This has not only interfered with food production but also with the economic activities in these countries, resulting in high levels of food insecurity [3].

A number of local, national and international partners are involved in interventions and research activities in these three countries with the objective of promoting food security. The Consortium for Improving Agriculture-based Livelihoods in Central Africa (CIALCA) works towards enhancing food security and improving livelihoods in Central Africa. CIALCA is an Africa-based partnership led by three international organizations: 1) Bioversity International, Kampala, Uganda; 2) International Institute on Tropical Agriculture (IITA), Kampala, Uganda; and 3) Tropical Soil Biology and Fertility Institute of the International Center for Tropical Agriculture (TSBF-CIAT), Nairobi, Kenya.

CIALCA's overall goal is to improve the livelihoods of agricultural-based communities in Central Africa by enhancing their capacity to access and efficiently use the resources needed to improve system productivity, resulting in a better income, nutrition and environment. In collaboration with national agricultural research systems, research teams at the Catholic Universities of Leuven (KU Leuven), Louvain-la-Neuve (UCL) and other partners, CIALCA has developed and disseminated over 30 technologies. Some of the technologies were on improved legume and banana/plantain varieties, plant disease management, profit enhancing and quality-management technologies. Guidelines on best cultural practices and collective marketing tools were also developed. The project activities in the three countries are implanted in 10 mandate areas. Within the mandate areas CIALCA operates in so-called 'action sites', where technologies are developed, evaluated and promoted, and through its development partners in 'satellite sites', where technologies are disseminated.

It is expected that in addition to increased production of the starchy staples, the adoption of better technologies regarding farming and post-harvest handling would enhance the ability of households to access a variety of nutrient/protein-rich foods either through their own farms or through enhanced purchasing power. The main milestone relating to food and nutrition was to increase the intake of protein among

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households within the intervention sites. The findings reported here are on a survey carried out after four years of project implementation to establish whether the target milestones have been met.

II. METHODOLOGY

The data for this study was derived from a cross-sectional survey of 913 households, conducted in Burundi, DRC and Rwanda, in July 2011. The sampling design followed a multi-stage procedure to select mandate area, village and household, respectively. First, 7 mandate areas out of the 10 mandate areas were purposively selected from the three countries. The 7 were selected intentionally because of the intensity of adoption of CIALCA technologies and types of crop produced. Second, five villages were randomly selected in each of the mandate areas, stratified into three main categories. The first group consisted of villages that hosted demonstrations of the technologies under consideration (action sites). Action sites are geographical zones covering one or a limited group of communities (comprising between 500 and 5,000 households). The second group involved neighboring villages that were referred as satellite site. Satellite sites are similar to action sites as far as size, population and other general characteristics are concerned. The differences are that the activities (the dissemination of the technologies) tested in the satellite sites are directed by development partners and the choice of these sites was based on presence of a development partner/NGO. The third group comprised of control villages. Criteria for selecting control villages were similar agro-ecological conditions if NGOs were present they were not promoting CIALCA products, and within a distance of 10-15 km from action sites.

Lists of households, compiled by CIALCA staff with the help of the chiefs at village level, and the lists existing for the baseline study, served as sampling frame from which households were randomly sampled Proportional to Size (PPS). A farm household was defined as a social entity that collectively makes productive and consumptive decisions and often eats from the same granary. Verbal consent was obtained from respondents and structured questionnaires used to collect valuable information on several factors including food sufficiency, caloric intake, intake of protein rich foods and reasons for changed level of food security

The data were managed and analyzed using SPSS (version 17) and STATA (version 10) statistical software. Data on food sufficiency and intake of protein-rich foods was summarized using frequencies. Food consumption data were elicited at household level covering all food items consumed within the last 2 days (48 hours) preceding the survey. Quantities were estimated using standardized food models and the quantities of proteins and calories in the specific foods estimated through use of food composition tables [4]. The total quantity of protein and calories consumed in a period of 24 hours by each household was established and compared to the protein and calorie needs of each household which were estimated based on household composition and protein and calorie Recommended Daily Intakes (RDIs) of each household

member. Through comparison of the estimated consumption and the required nutrients, the percentage of protein and calorie needs being met by households was established.

To establish the overall impact of the project on food and nutrition security, findings of households in CIALCA's action and satellites sites were compared to households in control sites. Differences in mean values on food sufficiency, consumption of protein and calories at the action, satellite and control sites were tested by analysis of variance (ANOVA) and determination of the significance of difference obtained by Tukey's HSD multiple rank test. All results were summarized using graphs.

III. RESULTS AND DISCUSSION

A. Food Security

Overall, the perception on household food sufficiency received a higher rating in the action and satellite sites, compared to the control sites (Fig. 1). Furthermore, in comparison with the intervention sites, a higher proportion of the households in the control sites indicated that there is often an insufficiency in quantity of food available for the household members, however this difference was not statistically significant ($p=0.150$) at 5% significant level.

Majority of the households in the survey indicated having sufficient quantity of food although not of the desired type. This supports findings by other researchers that have reported monotonous non-diversified food consumption among households in DRC and Burundi [5],[3].

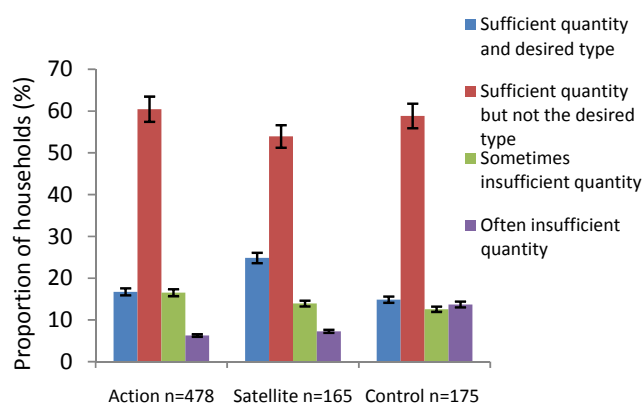


Fig. 1 Perception of household food sufficiency by site location

In all three countries, the proportion of households that indicated having sufficient quantity of food to eat of the desired type was higher in the action sites compared to the control sites (Fig. 2). Although the differences in Burundi and Rwanda were not significant, in DRC the proportion of households was significantly higher in the satellite (19%) and action sites (14%) as compared to the control sites (8%) at a p -value of 0.05 (Fig. 2).

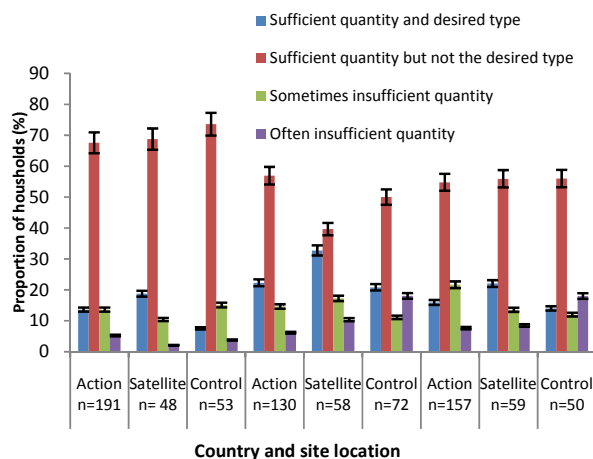


Fig. 2 Perception of household food sufficiency by country and site location

In the survey attention was paid to the perception on change of the household's food security over the past three years. Generally, in the action and satellite sites a higher proportion of households indicated that their food security improved over this period (34% and 40% respectively), compared to the control sites (25%)(Figs. 3, 4). These positive results for CIALCA's intervention sites apply to all three countries.

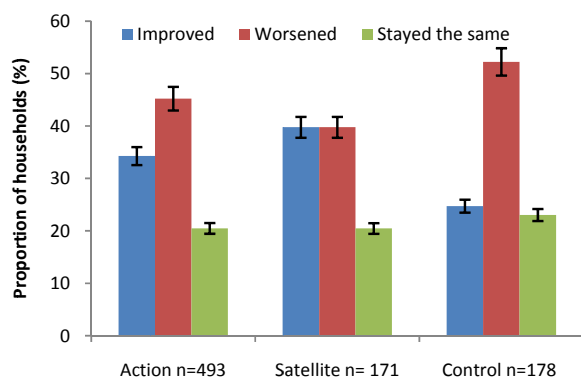


Fig. 3 Perception on change in food security over the last 3 year by site location

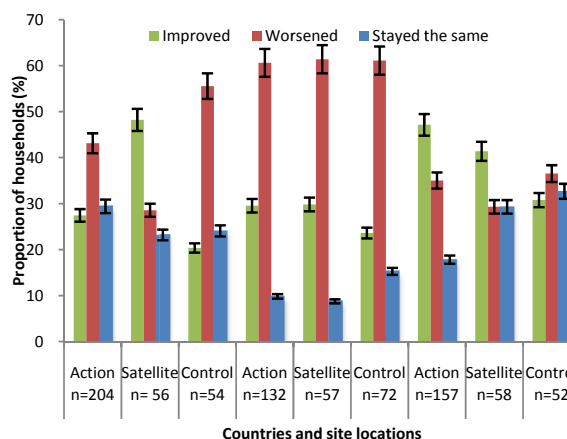


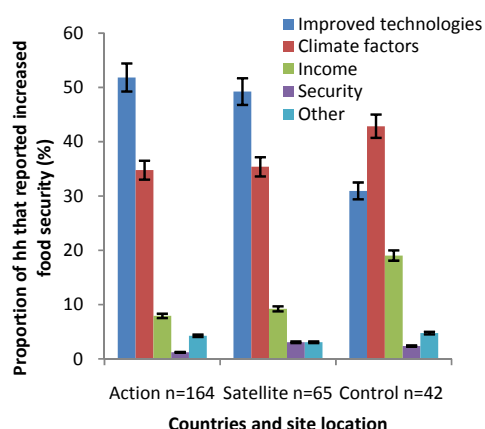
Fig. 4 Perception on change in food security over the last 3 year by country and site location

Although the differences between the action and satellite sites were not statistically significant in any of the countries, the proportion of households reporting improvement of their food security was significantly higher in all action sites as compared to the control sites (Fig. 4).

The percentage of households that reported worsened food security was higher in the control sites as compared to the action sites (Fig. 3), and this difference was statistically significant giving a p-value of 0.005. Food security seemed to have deteriorated the most in Burundi in the past 3 years, where 61% of the households indicated worsening of the situation. In DRC the proportion of households reporting worsened food security was significantly higher in the control sites as compared to the action and satellite sites. The results in Rwanda showed the same trend, but in this country the differences were not statistically significant ($p=0.05$) (Fig. 4).

The dominant factor respondents reported for improved household food security was the use of improved agricultural technologies, followed by favorable climatic conditions (Fig. 5). In the action and satellite sites, a larger proportion of households reported that their improved food security could mainly be assigned to the use of improved technologies than in the control sites. The fact that households attributed improved food security to new agricultural technologies is very important for adoption of these technologies. It is plausible that this positive result can be ascribed to CIALCA's interventions.

There are however large differences between countries (Fig. 6). In DRC more than 60% of the households at the action sites cited improved technology as the reason for improved food security, and improved income came second. In Burundi, the main reason was favorable climatic conditions followed by improved technologies, while in Rwanda at both action and satellite sites improved technologies was the main contributor followed closely by favorable climatic conditions.



For the households that indicated worsened food security, majority of them (on average >60%) stated that this was due to climatic conditions that eventually led to low farm produce. These findings concur with those by the Rwandan government indicating that Rwandan farmers are highly vulnerable to the variable climate, drought being a regular hazard [6].

Fig. 5 Reasons given for improved food security by site location

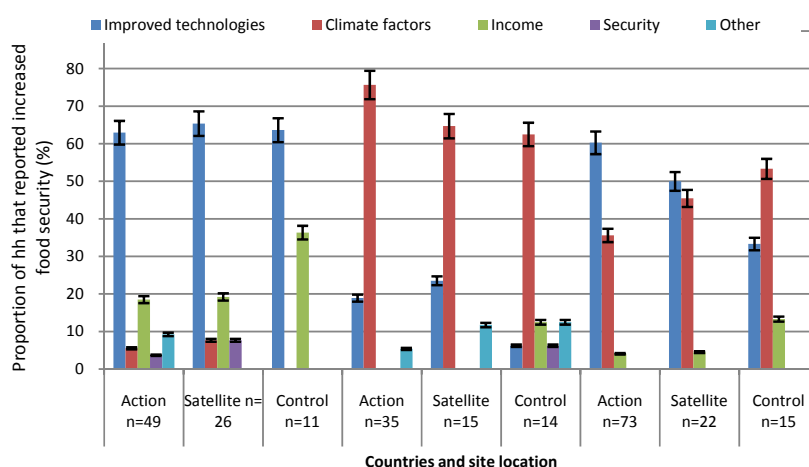


Fig. 6 Reasons given for improved food security by country and site location

Although low farm size was not cited as a major cause of food insecurity, some reports on surveys carried out in Rwanda suggest that the root cause of food insecurity is the very small average size of farming plots [6]. The government estimates that 60% of the population is dependent on farms of less than 0.7 hectares, the approximate threshold for providing sufficient food or income. Further downward pressure on farm sizes is exerted by a high population growth rate of 2.8% per annum. The density of about 370 people per square kilometer is already the highest in Africa and the population is projected to increase by a further 30% over the current decade [6]. Drought has been reported as a major cause of food insecurity in Burundi [7] while in Eastern DRC the persistent civil conflict has been cited as the main contributor to food insecurity, mainly because households abandon agricultural and marketing activities [3].

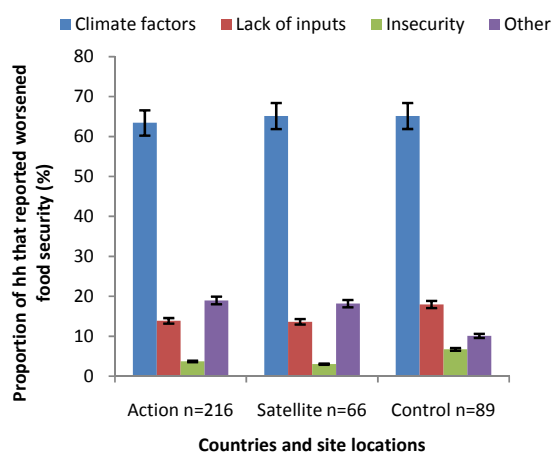


Fig. 7 Reasons given for worsened food security by site location

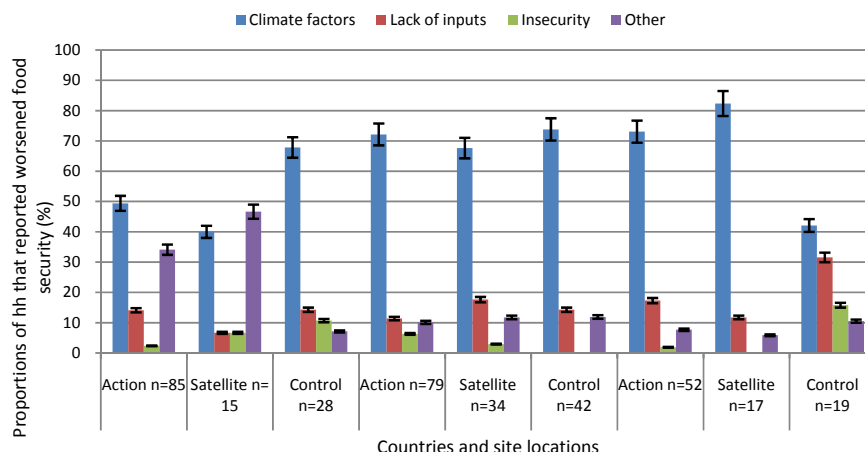


Fig. 8 Reasons given for worsened food security by country and site location

In most African settings, a household considers itself food secure if it has enough of the popular staple (personal communications). The popular staples in DRC, Rwanda and Burundi include cassava, cooking banana, maize and sweet potato. These are the main providers of calories and it is therefore likely that a population that considers itself food insecure is not meeting its daily calorie requirements. The calorie quantities in all food items consumed in a day by each household was summed up and compared to the Recommended Daily Intake (RDI) of the whole family.

Findings in Fig. 9 show that although the proportion of households in the action sites meeting the calorie RDIs was slightly higher compared to the satellite and control sites, the differences in were not statistically significant.

Despite this, there are considerable country differences. The findings presented in Fig. 10 show that all site locations in DRC recorded higher proportions of households meeting their daily calorie requirements as compared to Burundi and Rwanda. This concurs with could the observation in Fig. 2 where the proportion of households reporting sufficiency in quantity of food (although not of the desired type) was higher in all sites of DRC as compared to Burundi and Rwanda. Although the proportion of households meeting their calorie RDIs in DRC and Burundi was higher in the action and satellite sites as compared to the control sites the difference was not statistically significant. In Rwanda the action and satellite sites had a lower proportion of households meeting their daily calorie RDIs as compared to those in the control sites but again this difference was not statistically significant at p-value of 0.05.

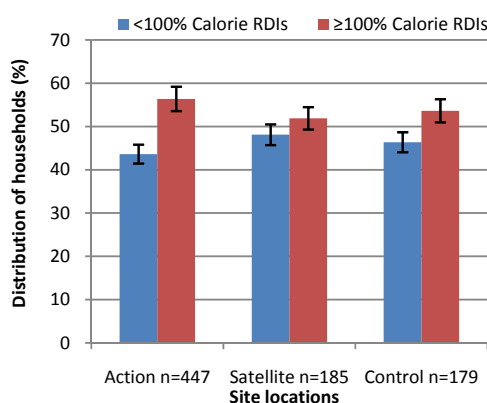


Fig. 9 Daily calorie requirements met by household by site location

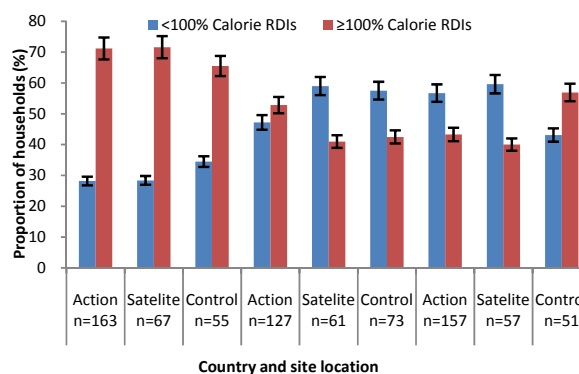


Fig. 10 Daily calorie requirements met by household by country and site location

B. Intake of Protein-Rich Foods and Actual Protein Intake

Overall, more than half of the respondents in the control sites (53%) of this survey indicated a decrease in intake of protein-rich foods over the past three years, which is higher than the proportion of households in the action and satellite

sites (46% and 41% respectively) (Fig. 11). In addition, the proportion of households that reported an increase in consumption of protein-rich foods was higher in the intervention sites in comparison with the control sites. Also the results for the individual countries show that the proportion of the households in the action sites that reported increase of protein intake is higher than in the control sites, whereas the proportion that reported decreased protein intake is lower (Fig. 12).

The results however show differences between countries (Fig. 12). In DRC, the proportion of households indicating increased intake of protein-rich foods was significantly higher in the action and satellite sites as compared to the control sites where about 60% reported decrease in intake of protein-rich foods. In Burundi, the majority of the households (>55%) in all sites (action, satellite and control) reported a decrease in intake of protein-rich foods. This is the highest percentage of all three countries. In Rwanda, the proportion reporting improvement in intake of protein-rich foods was significantly higher in the action sites as compared to both the satellite and control sites. The proportion of those reporting that the intake

remained the same was significantly higher in the control sites compared to the satellite and action sites.

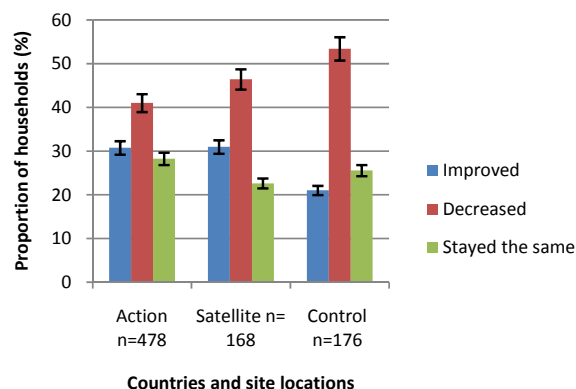


Fig. 11 Perception regarding change in intake of protein-rich foods over the last 3 years by site location

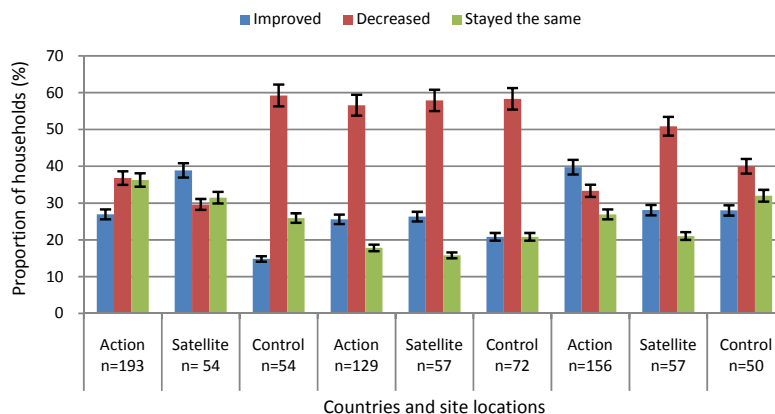


Fig. 12 Perception regarding change in intake of protein-rich foods over the last 3 years by country and site location

All three countries and all site locations considered, the dominant reason for increased intake of protein-rich foods is improved technologies. The data presented in Fig. 13 show that the percentage of households that regard improved technologies as the main factor for their increased protein intake is higher in the action and satellite sites than in the control sites. It is very plausible that this positive result is caused by CIALCA's interventions and dissemination of new agricultural technologies. This same reason was cited earlier as a factor contributing to improved food security. It is therefore possible that by scaling out CIALCA's technologies (involving food production, disease control, and post-harvest handling) further, more households will benefit resulting in access to more food and more varied types of food.

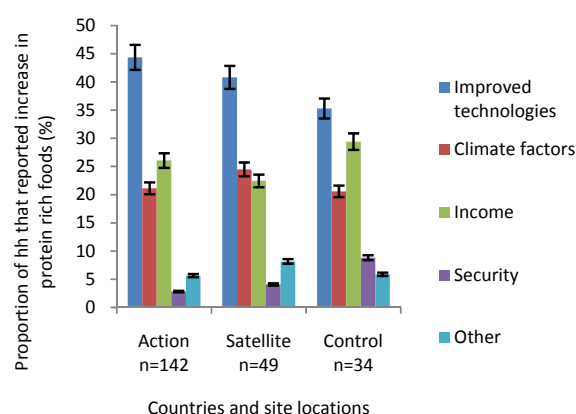


Fig. 13 Reasons for increase in intake of protein-rich foods by site location

Increased income is the second reason for increased protein intake. This could mean that, in addition to use of the technologies, the households were either able to obtain protein-rich food sources from the market, include protein-rich plants on their farms or rear small animals and chicken that could provide food items such as milk, eggs, meat, etc.

For the households in DRC that reported increase in intake of protein-rich foods over the last 3 years, improved technology was the main reason in all the sites (Fig. 14). In the action sites, the proportion indicating an increase in income as the main contributor was also high.

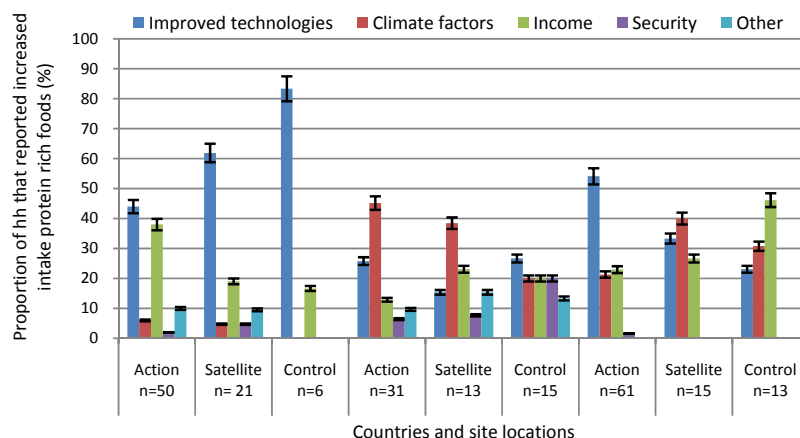


Fig. 14 Reasons for increase in intake of protein-rich foods by country and site location

In Burundi, the main reason for increase in intake of protein-rich foods -especially in the action sites- was favorable climatic conditions, followed by increased technology. These were the same reasons cited for an increase in the household food security situation.

In Rwanda, a significantly high proportion of the households in the action sites indicated improved technology as their main reason for increased protein intake.

For the households that indicated a decrease in intake of protein-rich foods, the reasons were quite different from those given for increase in intake (Figs. 15 and 16). In Burundi and Rwanda, the main reasons given were unfavorable climatic conditions followed by a lack of farm inputs. In DRC, the listed reasons were not the main causes of decrease in protein intake, there were other factors that were leading to this and they were not specified.

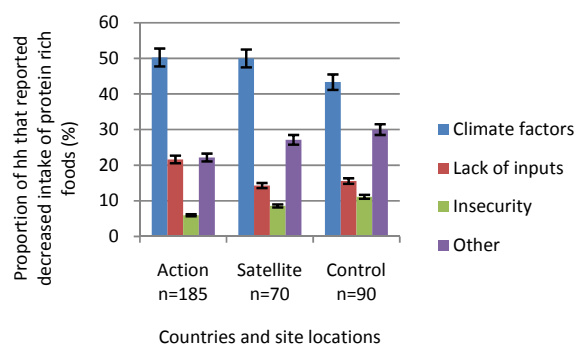


Fig. 15 Reasons for reduced consumption of protein-rich foods over the last 3 years by site location

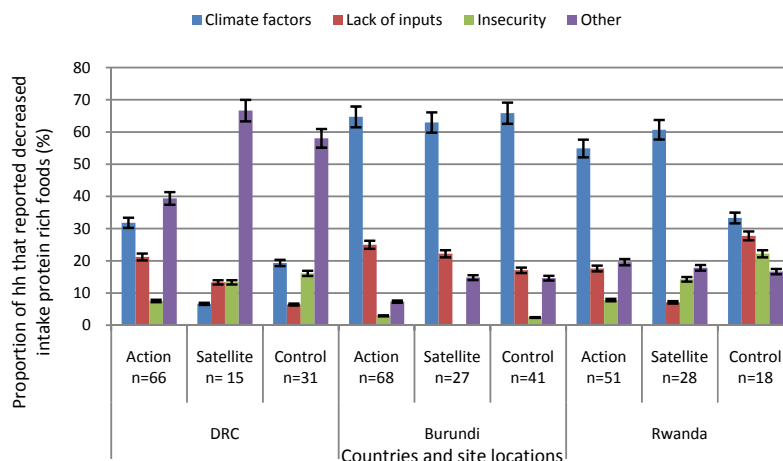


Fig. 16 Reasons for reduced consumption of protein-rich foods over the last 3 years by country and site location

Findings shown in Fig. 17 indicate that the proportion of households meeting their RDIs ($\geq 100\%$) was slightly higher in the action sites as compared to the satellite and control sites. Nevertheless, the difference observed was not statistically significant ($p=0.05$).

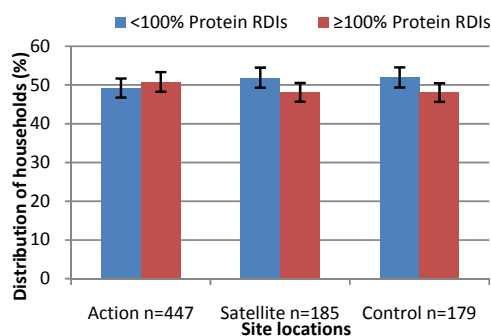


Fig. 17 Percentage of protein taken in relation to total protein RDIs of household by site location

The results show that although more than half of the households (55-61%) in all site locations of DRC were meeting their daily protein RDIs. For those not meeting their RDIs, the proportion was considerably higher in the control sites as compared to the action and satellite sites (Fig. 18). This is in agreement with the higher proportion of households in the action sites that had earlier reported an increase in consumption of protein-rich foods. In Burundi and Rwanda, majority of the households are not meeting their protein RDIs. Although in both countries, a larger proportion of households in the action sites seem to be meeting their protein RDIs, as compared to those in the satellite and control sites, the difference observed is not statistically significant.

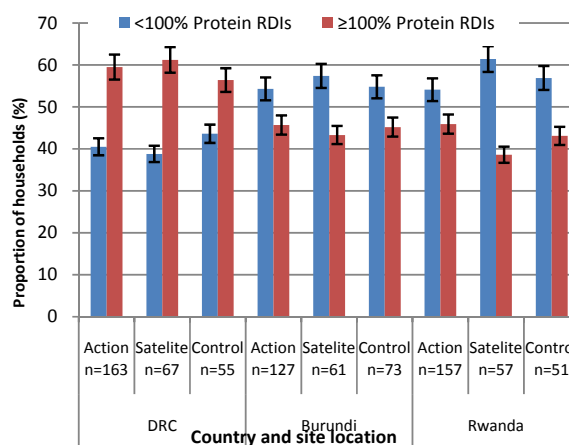


Fig. 18 Percentage of protein taken in relation to total protein RDIs of household by country and site location

IV. CONCLUSIONS AND RECOMMENDATIONS

The data presented show significant differences in perception of (change of) food security between the action and satellite sites and the control sites, as well as differences in actual calorie intake. The same applies for the outcomes on intake of protein-rich foods, for both perception and actual intake. Overall, a higher proportion of the households in CIALCA's intervention areas report positive changes in food security and protein intake, compared to the control groups. Furthermore, improved technologies are more frequently mentioned in the intervention sites as underlying reasons of these positive changes in food and nutrition security. It is plausible that these positive results can be ascribed to CIALCA's interventions.

The food security results presented in this paper indicate that, overall, there are no major differences in outcomes between the action and satellite sites. This may indicate that

the new agricultural technologies tested by CIALCA in the action sites, are well disseminated in the satellite sites.

There are however several country differences. It would be interesting to learn more about the underlying reasons for these differences, to be able to come up with suitable, country specific interventions.

In this survey several key indicators have been used to describe food and nutrition security. Next to sufficient calorie and protein intake, dietary diversity is essential to achieve nutrient adequacy. Monotonous diets, mainly based on grains, roots and tubers, are common in areas of high food insecurity and contribute to the burden of malnutrition [8]. Dietary diversification is a recommended approach to alleviate nutritional problems caused by food insecurity and inadequate intake of micronutrients.

CIALCA implemented interventions that stimulate consumption of diversified and nutritious food baskets i.e. promotion and support of diversified home gardens through intercropping, encouraging establishment of kitchen gardens and promotion of mixed farming (including small animals and poultry into existing farming systems).

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