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Integration of Nutrition into the Training Curricula of the Matourkou Agricultural Centre in Burkina Faso

Roger Sodjinou [1,2*], Jacques Thiamobiga[3], Sylvestre Tapsoba[4], Djibril Cisse[4], William K Bosu[2], Nadia Fanou[5], Denis Garnier[4], Biram Ndiaye[6], Noel Zagre[1], Helene Schwartz[1], Félicité Tchibindat[7] and Mohamed Ag Bendech[8]

[1]UNICEF Regional Office for West and Central Africa, Dakar, Senegal

[2]West Africa Health Organization (WAHO), Bobo-Dioulasso, Burkina Faso

[3]Matourkou Agriculture Training Centre, Matourkou, Burkina Faso

[4]UNICEF Burkina Faso Country Office, Ouagadougou, Burkina Faso

[5]University of Abomey-Calavi, Benin

[6]UNICEF Tanzania Country Office, Dar es Salaam, Tanzania

[7]UNICEF Cameroon Country Office, Yaoundé, Cameroon

[8]FAO Regional Office for Africa, Accra, Ghana

***Corresponding author:** Roger SODJINOU, 01 BP 2715 Ouagadougou 01, Burkina-Faso; Tel: +226-65-24-51-51; Email: rsodjinou@gmail.com

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Abstract

Background: There is heightened interest in strengthening the linkages between agriculture and nutrition so that agriculture education systems become more nutrition-sensitive. This study was conducted to document the process of integrating nutrition into the training curricula of the Matourkou Agriculture Training Centre (CAP/Matourkou) in Burkina Faso. It also aimed to identify the challenges as well as the opportunities related to this mainstreaming process.

Methods: Data were collected between August and October 2015. The nutrition content of the curricula was evaluated against the following criteria: i) Scope of the nutrition topics covered; ii) Method of integration of nutrition in the revised curricula; and iii) Method of delivery of nutrition instruction. A written test was conducted to assess the extent to which the process had contributed to improving students' knowledge in nutrition. Only students in the agricultural engineering program took the test. Focus group discussions and semi-structured interviews were also conducted to evaluate the perceptions of key stakeholders about the process. The discussions were guided by the SWOT (Strengths, Weaknesses, Opportunities and Threats) analytical framework.

Results: An iterative and multi-stakeholder process was used by CAP/Matourkou to integrate nutrition into its existing curricula. Nutrition mainstreaming occurred at two levels: i) Vertical integration through which stand-alone nutrition courses were added to the curriculum for agricultural engineers, higher level technicians and agricultural agents; and ii) Longitudinal integration where nutrition was embedded into relevant agriculture-specific subjects (13 subjects in the curriculum for agricultural engineers, 3 for higher level technicians, and 2 for agricultural agents). This resulted in a short-term improvement in students' knowledge in nutrition. Students who received nutrition instruction under the revised curricula scored significantly higher than those that did not (mean score: 53.2±10.0 vs. 45.7±10.8, $P<0.01$). However, the vast majority of them (77.1%) scored around the average or below (<60%) for the test, indicating the need for increased training and exposure to nutrition. The most frequently reported strengths were the use of a structured approach and ownership of the process by CAP/Matourkou. Lack of internal communication about the process, insufficient training of faculty members in nutrition, and lack of nutrition courses emphasizing practical skills emerged as the major weaknesses.

Conclusions: Our data indicate that nutrition was effectively mainstreamed into the training curricula of CAP/Matourkou in Burkina Faso. However, efforts should be made to expand students' knowledge in nutrition. It is important to expose them to nutrition courses that emphasize practical skills. Opportunities should also be created for faculty members to upgrade their capacity to teach nutrition-sensitive courses. Key technical partners, such as UNICEF, FAO and other international organizations, should continue to provide a multi-level support to the process. This will ensure the sustainability of the approach and make the training programs offered by CAP/Matourkou more nutrition-sensitive.

Keywords: Nutrition, Training, Agriculture, Nutrition-sensitive, Burkina Faso.

Background

Burkina Faso is among the 36 high burden malnutrition countries in the world [1]. The prevalence of child stunting is 33%, with nearly one million of children under five being affected [2]. Eleven percent of children under five are wasted and 14% are born with low-birth weight [2]. Micronutrient deficiencies are common among children and women. Half of the women in reproductive age group are anemic [2] while 54% of children under five are deficient in vitamin A[3]. Burkina Faso is not on course to meet the five World Health Assembly's targets on nutrition [2]. However, the country has made good progress in the area of infant and young child feeding. Moreover, there are prospects for good nutrition governance and the promotion of multi-sectoral nutrition programming as well as alignment towards a common results framework [4].

There is now a growing momentum for evidence-based, sustainable and multi-sectoral nutrition interventions delivered at scale to accelerate progress for nutrition [5]. Investment in large-scale nutrition sensitive programs can address, not only the underlying causes of under nutrition, but also provide a platform for scaling-up of nutrition-specific interventions [6]. Agriculture is one of the sectors that can be leveraged to achieve sustainable reduction in under nutrition[7,8]. There is, indeed, a heightened international interest in linking agriculture with nutrition [5,7,8].

Burkina Faso has taken steps to integrate nutrition into its agricultural policies [9]. The government has recently adopted a national policy on food and nutrition security, which includes nutrition as a key component. The country has also developed a nutrition-sensitive agriculture investment plan under the framework of the Comprehensive Africa Agriculture Development Program (CAADP). Clearly, there is a positive move towards exploiting the potential of agriculture for nutrition in the country. Agriculture professionals in Burkina Faso can play a key role in this process. As in other African countries, they work closely with rural farmers and provide them with the technical assistance and advisory services they need to boost their agricultural production [10]. The integration of nutrition-oriented modules into the pre-service or in-service training curricula of agriculture professionals could therefore provide a platform for the delivery of best nutrition practices to rural communities [10,11]. It was against this background that the *Centre Agricole Polyvalent de Matourkou* or the Matourkou Agriculture Training Centre (CAP/Matourkou), the only professional training Centre of the Ministry of Agriculture of Burkina Faso, started a program to integrate nutrition into its pre-service curricula during the 2013-2014 academic year, under an Africa's Nutrition Security Partnership (ANSP) initiative with support from the European Union (EU) and the United Nations Children's Fund (UNICEF), and in partnership with key stakeholders (FAO, Hellen Keller International, etc).The revised training curricula pertained to agricultural engineers (AE), higher level technicians (HLT), and agricultural agents (AA).

This paper describes the process of integration of nutrition into the training curricula of CAP/Matourkou. It assesses the scope of nutrition topics covered in the revised training curricula and evaluates the extent to which the nutrition mainstreaming process has contributed to improving the knowledge and skills of students in nutrition, while identifying the associated challenges and opportunities.

Methods

Study Area

The CAP/Matourkou, located in Bobo-Dioulasso, was established in 1963 as an institution of higher education and research in agricultural sciences [12]. Its mandate is to train students to acquire high-level agricultural techniques in order to support farmers. The training involves classroom-based taught courses, field visits and internships across the different agro-ecological zones of the country. The Centre had trained more than 4,500 people by 2014 [12].

Currently, the training for AE is the highest level of the three programs offered at CAP/Matourkou. Higher Level Technicians in agriculture with three years of professional experience or students with postgraduate diploma in chemistry, biology, agronomy or a related field are eligible for admission. Training lasts three years, after which graduates are expected to design innovative solutions to help farmers and rural communities to maximize their agricultural diversified production and productivity.

The training for Higher Level Technicians is aimed at Agricultural Agents with three years of professional experience or students with general college degrees in biology, mathematics, physics or a related field. After their two-year training, graduates are equipped to help farmers solve problems relating to agricultural production and practice.

The third program trains Agricultural Agents. Students with a high school diploma are eligible for admission. The two-year training equips them to provide direct technical assistance and advisory services to farmers and rural communities.

Data collection

Data were collected between August and October 2015 from various sources: i) Desktop review of literature on the mainstreaming process; ii) Evaluation of the scope of nutrition topics introduced into the curricula; iii) Evaluation of the effect of the revised curricula on the knowledge and skills of students in nutrition; and iv) Focus group discussions (FGDs) and semi-structured interviews on the perceptions and experiences of students, management and faculty members on the process.

Desktop review of the mainstreaming process

A literature search was conducted to review available reports and key documents related to the nutrition mainstreaming process. The documents (available upon request) included:

i) Report of an ANSP inception worksho;

ii) Report of a workshop organized to define key nutrition topics to be included into the revised curricula;

iii) Report of a curriculum revision workshop;

iv) Report of a workshop organized to validate the proposed revised curricula;

v) Report of the training workshop organized to strengthen the capacity of faculty members to teach nutrition courses;

vi) Various internal monitoring reports related to the process; and

vii) ANSP external mid-term evaluation report.

Scope of nutrition topics introduced into the curricula

The criteria used to assess the revised curricula were the content and scope of the nutrition topics covered; the method of integration of nutrition; and the method of delivery of nutrition instruction.

Effect of the revised curricula on students' knowledge and skills in nutrition

We evaluated the effect of the students' knowledge and skills in nutrition by comparing the performance of one group of students trained with the curricula and another group of untrained students on a 90-minute written test. The 'exposed' group (Group A) was made up of 48 second year agricultural engineering students who had already received nutrition instruction under the revised curriculum. The control group (Group B) was made up of 24 first year agricultural engineering students who had not received nutrition instruction. The written test, which was done anonymously, included 19 open-ended questions related to the nutrition topics covered in the revised curricula. We could not select students in the final year of the agricultural engineering program as they were in the field for their internship at the time of data collection.

Focus group discussions and semi-structured interviews

FGDs were conducted separately with 14 faculty members (3 faculty members dedicated to nutrition and 11 faculty members teaching agriculture-related courses) and 6 senior members of CAP/Matourkou to discuss their perceptions, needs, expectations and challenges relating to the process of mainstreaming nutrition into the agricultural training curriculum.

As it was not possible conduct a FGD with the students because of their relatively large number, we asked the 48 students of the AE program who had received nutrition instruction under the revised curriculum (Group A) to fill in a questionnaire which included questions on their perceptions, needs, and expectations about the nutrition mainstreaming process. All the discussions and interviews were held at CAP/Matourkou and were guided by the SWOT (*Strengths, Weaknesses, Opportunities and Threats*) analytical framework.

Data analysis

Quantitative data were cleaned and analyzed in SPSS 14.0. The scores for the knowledge test were expressed in percentage (ranging from 0 to a maximum of 100). Four categories of score were created: poor score (<50%), average score (50-59%), good score (60-79%) and very good score (≥80%).Student's t-test was used to assess the difference between the mean scores for the written test for the two groups. Chi-square test was used to assess the difference in the demographic characteristics of students that took the test. The level of significance was set at $P<0.05$ for all tests.

Qualitative data analysis consisted at identifying the major themes that emerged from interviews. Data were entered into Microsoft Excel 2010.The discussions were transcribed and content analysis used to categorize the perceptions of students, faculty members and the management of CAP/Matourkou according to each of the four SWOT elements.

Results

Description of the process used to integrate nutrition into training curricula

An iterative process involving multi-stakeholder consultation was used by CAP/Matourkou to integrate nutrition into its existing curriculum for agricultural engineers, higher level technicians, and agricultural agents. The Centre received the support of a large number of national and international organizations including the Ministry of Agriculture; Ministry of Health; National School for Public Health; National Forestry Training Institute; The United Nations Children's Fund (UNICEF); The United Nations Food and Agriculture Organization (FAO); *Institut de Recherche en Sciences de la Santé* (IRSS); *Institut de l'Environnement et de Recherches Agricoles* (INERA); and the *Institut de Développement Rural* (IDR). These entities were involved throughout the process of revision, validation, and implementation of the new curricula.

The nutrition mainstreaming process comprised the following steps:

i) Definition of the objectives of the process and key results to achieve;

ii) Orientation workshop to build consensus on the process;

iii) Identification of key nutrition topics to include into the revised curricula;

iv) Curriculum revision;

v) Validation of the proposed new curricula;

vi) Training of trainers workshop to strengthen the capacity of faculty members in nutrition;

vii) Implementation of the new curricula; and

viii) Monitoring of the implementation of the process (Table 1).

ANSP inception workshop–main objectives of the mainstreaming process and expected results

The process was conducted within the framework of the EU-UNICEF ANSP which aims to promote nutrition security in Africa through the implementation of a set of interventions articulated around four main pillars: integration of nutrition security within national development policies and nutrition security awareness; capacity strengthening for nutrition and institutionalization of multi-sectoral nutrition; reinforcement of nutrition information systems; and scaling up of specific nutrition interventions. The focus countries for the ANSP program were Burkina Faso, Mali, Ethiopia and Uganda, with the possibility of expanding the program to other African countries in the coming years.

The nutrition mainstreaming process fell under the second pillar of the ANSP in Burkina Faso. It was implemented with direct

support from UNICEF, FAO and other partners. The inception workshop of the ANSP program, which was held in Bamako, Mali from 22 to 24 February 2012, allowed all stakeholders to discuss, among others, the integration of nutrition into the training curricula of CAP/Matourkou and the key results to be achieved (Table 1). The workshop was attended by the participants of the four target countries and external partners. Burkina Faso was represented at the inception workshop by eight delegates from seven institutions including CAP/Matourkou.

Orientation workshop

An orientation workshop, aimed at enabling stakeholders to have a common understanding about the nutrition mainstreaming process and the results to be achieved, took place in Banfora, Burkina Faso, from 12 to 15 July 2012.The workshop also oriented participants on the broader concept of nutrition security and the linkages between agriculture and nutrition. It was attended by 28 participants from 9 institutions.

Identification of key nutrition topics to include into existing Matourkou training curricula

A total of 38 participants from 10 institutions gathered in Matourkou from 15 to 17 October 2012 to define the key nutrition topics to incorporate into the curricula of CAP/M. During the workshop, participants agreed to enhance existing curricula through vertical and horizontal integration of nutrition. The choice was clearly made not only to add stand-alone nutrition courses, but also, to integrate nutrition into all relevant subjects being taught at CAP/Matourkou so as to address both nutrition-specific and nutrition-sensitive issues. The main outcome of the workshop was the identification of the key nutrition topics to be added into the existing curricula (Table 2).

Curriculum revision

A core group of 32 participants met in Banfora from 13 to 15 December 2012 to revise the curricula according to regional standards. The group developed a teaching package for each of the courses or topics related to nutrition. The package for stand-alone nutrition courses included the following elements: i) learning objectives, ii) skills and competencies expected from students at the end of each course, iii) course structure and content, iv) course requirement, v) teaching method, vi) instruction time, vi) evaluation methods, and vii) implications of the revision (in terms of logistic and didactic needs). The package for agriculture-specific courses in which nutrition was embedded included the key aspects of nutrition to emphasize in the course, and the skills and competencies in nutrition expected from students at the end of the course.

Validation of the proposed curricula

A validation workshop, attended by 55 persons from 14 institutions, was held in Bobo-Dioulasso from 04 to 05 April 2013. The draft training packages, prepared by the core group during the curriculum revision workshop, were discussed in groups. The validation workshop adopted a set of revised training curricula (Table 3).

Training of faculty members in nutrition

A training workshop was organized from 26 to 30 August 2013 to build the capacity of 27 faculty members of CAP/Matourkou to teach nutrition courses. The topics covered included an overview of the basic concepts on food and nutrition security, the prevention and management of malnutrition, nutrition education, and skills on behavior change and interpersonal communication. The training was done by an experienced

Table 1: Nutrition mainstreaming process at CAP/Matourkou

No.	Date	Title	Location	Number of participants	Objective
1	22 - 24 Feb 2012	ANSP inception workshop	Bamako, Mali		To allow all stakeholders to discuss the integration of nutrition into the training curricula of CAP/Matourkou and the key results to be achieved
2	12 - 15 Jul 2012	Orientation workshop	Banfora, Burkina Faso	28	To enable all stakeholders to have a common understanding about the nutrition mainstreaming process and the results to be achieved
3	15 - 17 Oct 2012	Identification of key nutrition topics	Matourkou, Burkina Faso	38	To identify key nutrition topics to add into the existing training curricula at CAP/Matourkou
4	13 - 15 Dec 2012	Curriculum revision	Banfora, Burkina Faso	32	To develop a teaching package for each of the courses or topics related to nutrition
5	04 - 05 Apr 2013	Validation workshop	Bobo-Dioulasso, Burkina Faso	55	To adopt curricula for implementation
6	26 - 30 Aug 2013	Training of faculty members in nutrition	Matourkou, Burkina Faso	27	To train teachers on the various aspects of nutrition
7	Nov 2013	Implementation of the new curricula	Matourkou, Burkina Faso		To train students with revised curriculum
8	28 - 29 Nov 2014	Monitoring of the implementation of the process	Farakoba, Burkina Faso		To discuss the implementation of the process and make recommendations for ongoing improvement

Table 2: Nutrition courses and topics to be integrated into each of the level of instruction at CAP/Matourkou

Level of instruction	Stand-alone nutrition courses (vertical integration)	Subject topics in which nutrition is embedded (horizontal integration)
Agricultural Engineers	• Human Nutrition 1: food groups; dietary diversity; nutritional requirements; malnutrition (definition, forms, causes and consequences); food consumption; nutrient intake and diet quality; body composition; prevention of malnutrition at community level • Human Nutrition 2: food security, nutrition security; linkages between food security and nutrition security; linkages between agriculture, nutrition and health; concrete actions to promote food and nutrition security at community level	• Botany • General and Rural Sociology • Introduction to food sciences • Agroforestry • Food processing methods • Fruit production • Horticulture • Grain science • Fat and legumes • Hygiene and food safety • Animal husbandry and poultry breeding • Agricultural extension systems • Entomology
Higher Level Technicians		• Special agriculture • Fruit production • Rural appraisal • Poultry breeding • Agroforestry
Agricultural agents	Basic nutrition: food groups, nutrients; malnutrition: forms, causes and consequences; food hygiene	• Rural appraisal • Poultry breeding

nutrition expert contracted by UNICEF.

Implementation of the new curricula

The implementation of the new curricula started in November 2013, at the beginning of the 2013-2014 academic year. At the time of data collection, the school was in the second year of the implementation of the revised curricula.

Monitoring of the implementation of the process

Periodic internal meetings were organized by CAP/Matourkou to monitor the implementation of the revised curricula and to make adjustments as necessary. All stakeholders involved in the process met in Farakoba, Burkina Faso, from 28 to 29 November 2014 to discuss the implementation of the process and make recommendations for ongoing improvement.

Assessment of the nutrition content of the curriculum

For the vertical integration, two stand-alone nutrition courses were added to the curriculum of students in the AE and HLT programs (Table 3). The topics covered in the *Human Nutrition 1* course were food groups, dietary diversity, nutritional requirements, malnutrition, food consumption, nutrient intake, and body composition. The focus was mainly on the linkages between food security and nutrition security in the *Human Nutrition 2* course. A dedicated nutrition course covering only some basic knowledge on nutrition was added to the curriculum of students in the AA program. For the horizontal integration, nutrition was embedded into 13 subjects of the AE program, 5 subjects of the HLT program, and 2 subjects for the AA program (Table 3). An important element of this horizontal integration was that nutrition topics were embedded in the agriculture-specific courses without adding instruction time. The method of delivery of nutrition instruction in the revised curricula was mainly didactic, with insufficient time devoted to practical hands-on training.

Assessment of students' knowledge in nutrition

The age and sex distribution of the two groups of students that took the written test were similar (Table 4). Students in the intervention group achieved statistically significant higher mean test scores than those in the control group (53.2±10.0 vs. 45.7±10.8, p=0.005).Within each group, the scores for the written test ranged from 35 to 80 in group A and from 20 to 65 in group B. About 73% of the students in the intervention group A scored 50% compared with half of the students in the control group B. There was no statistically significant difference in the mean score for the test between male and female within each group. However, within each comparison group, students aged > 30 years scored significantly higher marks than younger students.

Assessment of the perceptions of students, faculty members and management about the process

The most commonly reported strengths were that the process was clear, straightforward, and involved many partners from

Table 3: Revised training curricula at CAP/Matourkou

	Agricultural Engineers		Higher level Technicians		Agricultural Agents	
Vertical integration (stand-alone nutrition courses)	Nutrition-specific courses	Topics covered	Nutrition-specific courses	Topics covered	Nutrition-specific courses	Topics covered
	Human Nutrition 1 (Semester 4; 25h)	Food groups, dietary diversity, nutritional requirements, malnutrition, food consumption, nutrient intake, and body composition	Human Nutrition 1 (Semester 1; 20h)	Food groups, dietary diversity, nutritional requirements, malnutrition, food consumption, nutrient intake, and body composition	Human Nutrition 1 (Semester 2; 25h)	Food groups, dietary diversity, nutritional requirements, malnutrition, food consumption, nutrient intake, and body composition
	Human Nutrition 2 (Semester 5; 30h)	Food security, nutrition security, linkages between food security and nutrition security	Human Nutrition 2 (Semester 2; 25h)	Food security, nutrition security, linkages between food security and nutrition security		
Horizontal integration (nutrition embedded in other subjects)	Agriculture-specific courses	Nutrition topics embedded in the course	Agriculture-specific courses	Nutrition topics embedded in the course	Agriculture-specific courses	Nutrition topics embedded in the course
	Botany	Nutritional values of non-timber products	Special agriculture		Rural appraisal	Behavior changes techniques
	General and Rural Sociology	-Nutrition and society -Attitudes and beliefs on diet and nutrition	Fruit production	Nutritional values of fruits	Poultry breeding	Importance of poultry breeding for diet quality
	Introduction to food sciences	Food groups and nutrition	Rural appraisal	Behavior changes techniques		
	Agroforestry	-Nutritional values of non-timber products -Importance for diet quality	Poultry breeding	Importance of poultry breeding for diet quality		
	Food processing methods	Nutritional values of agricultural products	Agroforestry	Nutritional values of non-timber products		
	Fruit production	-Nutritional values of fruits -Importance for diet quality				
	Horticulture	-Nutritional values of horticultural products -Importance for diet quality				
	Grain science	Nutritional values of grains				
	Fat and legumes	-Nutritional values of fat and legumes -Importance for diet quality				
	Hygiene and food safety					
	Animal husbandry and poultry breeding	-Nutrition values of animal products -Importance for diet quality				
	Agricultural extension systems	Communication and behavior changes techniques				
	Entomology	Nutritional values of insects				

Table 4: Demographic characteristics and written test scores compared between students trained with new nutrition curriculum versus students not similarly trained

Item			Group A (Intervention Group) (n=48)	Group B (Control Group) (n=24)	P-value
Demography					
Mean age ± SD*			30.2±4.6	31.3±5.5	0.378
% ≤30 years**			43.8	50.0	0.400
% male**			89.6	75.0	0.103
Between curriculum comparison*	Mean test scores ± SD (maximum = 100)		53.2±10.0	45.7±10.8	0.005
Within curriculum comparison	Range		35-80	20-65	-
	Level of knowledge in nutrition	% with poor score (<50%)	27.1	50.0	-
		% with average score (50-59%)	50	37.5	
		% with good score (60-79%)	20.8	12.5	
		% with very good score (≥80%)	2.1	0.0	
	Test scores according to sex groups	Female	50.5±9.4	44.2±8.6	-
		Male	53.5±10.2	46.3±11.6	
		P-value*	0.527	0.691	
	Test scores according to age groups	≤30 years	49.3±8.6	41.5±11.4	-
		>30 years	56.3±10.1	50.0±8.5	
		P-value*	0.015	0.005	

*Student's t-test of comparison of means
**Chi-square test of comparison of proportion.

different organizations (Table 5). Lack of internal communication about the process was the most reported weakness. Other weaknesses were insufficient training of faculty members in nutrition, limited access of students to learning materials on nutrition, lack of clarity on the competencies that students are expected to exhibit upon graduation, and limited number of nutrition courses that emphasize practical skills. The commonly reported opportunities were the possibility for students and faculty members to upgrade their knowledge in nutrition, the potential expansion of partnerships between CAP/Matourkou and national and international institutions working in nutrition, and the possibility for the Centre to generate additional resources through services and consultancies in nutrition.

Discussion

In this study, we assessed the process of integration of nutrition into the training curricula of CAP/Matourkou and identified the associated challenges and opportunities. Our results indicate that a straightforward, iterative and multi-stakeholder process was followed by CAP/Matourkou, leading to the vertical and horizontal integration of nutrition into existing curricula. A similar approach was also used in Mozambique for the revision of pre-service curriculum for non-physician clinicians [13]. Overall, according the beneficiaries and stakeholders, the process to include nutrition in all relevant curricula at CAP/Matourkou was successful. It was simple, clear and reproducible. Key drivers to success were the use of expertise from a large number of organizations working in various fields (agriculture, health, nutrition, and education) and the establishment of a core group of motivated technical experts who reviewed and validated the curricula. The fact that CAP/Matourkou took a great ownership and facilitation of the process was also critical for success.

Another important element was the approach taken to mainstream nutrition courses into existing curricula. For the three levels of instruction at CAP/Matourkou, stand-alone nutrition courses were supplemented by nutrition topics embedded in agriculture-specific courses throughout the curriculum. This comprehensive approach has been recommended for the integration of nutrition into the curriculum for health professionals in West Africa [14] and other settings [15,16]. Although the revised curricula covered the basic knowledge on nutrition, it lacked focus on nutrition topics which emphasize practical skills. The curricula did not, for example, emphasize the promotion of nutrition at community level through communication or behavior change techniques or nutrition education, an area where students of CAP/Matourkou are expected to play a key role after graduation. The limited practical-oriented courses could be attributed to the mainly didactic method of delivery of nutrition instruction at CAP/Matourkou. Large class sizes hinder practical training. There are, for example, more than 200 students in the AA program for the 2014-2015 academic year. We have highlighted the importance of applied nutrition and hands-on practical skill development for health professional training in West Africa [14,17].

We found that students who received nutrition instruction under the revised curricula scored significantly higher than those who

Table 5: SWOT analysis elaborated from the perspective of different stakeholders

	Students	Faculty members	Management of CAP/Matourkou
Strengths	• The process allowed them to better understand the linkages between agriculture, nutrition and health	• The process was well planned, systematic and clear • The use of a multi-stakeholder approach for curriculum revision (validation of training curricula by experts of 14 national organizations involved in higher education and/or agriculture, health and nutrition)	• Multi-stakeholder process • The process was straightforward, efficient and transparent • Great ownership and facilitation by CAP/ Matourkou
Weaknesses	• Poor participation of students in the nutrition mainstreaming process (many of them said that they were not involved in the different steps of the process) • Lack of information about the process (many students heard about the process at the time of data collection) • Lack of nutrition courses emphasizing practical knowledge in the curriculum • Limited access to learning materials on nutrition	• High staff turnover (especially those that were trained in nutrition) • Insufficient training of faculty members in nutrition (the training they received in nutrition was too short- only 3 days) • Insufficient communication about the process • Most teachers expressed that it was really a new domain. As a result, it was difficult for them at the beginning to include nutrition into their courses.	• Insufficient communication about the process • Absence of a clear vision to ensure ownership of the processs • lack of clarity on the competencies that students are expected to exhibit upon graduation
Opportunities	• Opportunities to do internship with international organizations working on nutrition • Job opportunities with international organizations working on nutrition after their graduation • Opportunities to pursue advanced studies in nutrition after their graduation	• Opportunity for CAP/M to develop new course on nutrition (for example in-service course on nutrition for agricultural professionals) • Opportunity to expand their knowledge in nutrition	• Opportunity to expand partnership with national and international institutions working on nutrition • Opportunity to generate additional resources through services and consultancies in nutrition
Threats	• Fear of not having the opportunity to apply the nutrition knowledge received after their graduation	• Lack of capacity development opportunities in nutrition may limit their motivation to integrate nutrition in their courses	• Lack of a long-term funding and support from partners may hinder the sustainability of the approach

did not. Given that some of the students in the control group may have been exposed to nutrition information, it can be argued that the true difference between the two groups may be greater. It is probable that the curriculum revision process has contributed to improving the knowledge of students in nutrition. However, the fact that the vast majority of them scored just around the average for the test suggests that the approach used by CAP/Matourkou may not be sufficient to improve their overall knowledge, skills and competencies in nutrition. This may partly be due to the fact that the students did the test several months after the nutrition courses had been taught. They may have scored higher marks if they had been tested within a few weeks of their training. The mainly didactic, non-interactive and non-competency based approach makes it easier to forget what has been learned.

A multi-level support is, therefore, needed to improve and sustain the knowledge and capacity of students in nutrition. First, it is crucial to empower faculty members to teach nutrition courses. The teachers have only had a brief experience with the revised curriculum. They will likely teach nutrition courses better as they become more familiar with the revised curriculum. During focus group discussions, most of them mentioned that the initial nutrition training that they received did not adequately prepare them to teach nutrition courses. The support to faculty members should, therefore, go beyond a one-off training and include a multi-level capacity development plan that includes elements such as mentoring, coaching as well as the provision of appropriate teaching material in nutrition [18]. National authorities should provide CAP/Matourkou with the opportunities to recruit nutrition specialists to improve its teaching capacity. Secondly, it is important to equip students with adequate learning materials on nutrition and provide them with the opportunities to do internships with national and international organizations working on nutrition. Lastly, opportunities must be created for students to gain hands-on practical knowledge in nutrition.

This study has some limitations. As only students in the AE program took the written test, our findings on the nutrition knowledge of students may not be applicable to those in the HLT and AA programs. Over time, we expect that the nutrition knowledge and skills will diffuse to the other programs. Beyond knowledge, it would have been good to also assess the skills and competencies of students in nutrition. Lastly, in future when the process has evolved, we would like to assess how graduates of CAP/Matourkou perform nutrition-related tasks after graduation.

Conclusion

Our data indicate that nutrition was successfully mainstreamed into the training curricula of CAP/Matourkou in Burkina Faso. However, efforts should be made to expand student's knowledge in nutrition. It is important to expose students to nutrition courses that emphasize practical knowledge. Opportunities should also be created for faculty members to upgrade their capacity to teach nutrition courses. Key technical partners should continue to provide a multi-level support to the process. This will ensure the sustainability of the approach and make the training programs offered by CAP/Matourkou more effective and tailored to the job description of agricultural professionals in Burkina Faso.

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Author's contribution

Roger Sodjinou, Biram Ndiaye and Félicité Tchibindat conceived the study. Sylvestre Tapsoba, Djibril Cisse and Jacques Thiamobiga contributed to the design of the study. Roger Sodjinou led data collection and wrote the first draft of the manuscript. All co-authors reviewed the manuscript and approved its final version for submission.

Conflict of interest

The authors declare that they have no competing interests associated with this study. The opinions and points of view expressed in this article are solely those of the authors and do not necessarily reflect the official positions or policies of their affiliated institutions. The study was funded by the European Union through the EU-UNICEF Africa's Nutrition Security Partnership (ANSP).

References

1. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, de Onis M, et al. Maternal and Child Nutrition Study Group. Maternal and child undernutrition and overweight in low-income and middle-income countries. Lancet. 2013; 382(9890):427-51. doi: 10.1016/S0140-6736(13)60937-X.
2. International Food Policy Research Institute (IFPRI). 2015. Global Nutrition Report 2014: Actions and Accountability to Advance Nutrition and Sustainable Development. Washington DC: International Food Policy Research Institute (IFPRI). Available from: http://globalnutritionreport.org/the-report/ [Cited 21 Sep 2015].
3. WHO. 2009. Global Prevalence of Vitamin A Deficiency in Populations at Risk 1995-2005. WHO Global Database on Vitamin A deficiency.
4. The Scaling Up Nutrition (SUN) movement. Available from: http://scalingupnutrition.org/sun-countries/burkina-faso[Cited 21 Sep 2015].
5. Webb P, Kennedy E. Impacts of agriculture on nutrition: nature of the evidence and research gaps. Food Nutr Bull. 2014; 35(1):126-32.
6. Ruel MT, Alderman H. Maternal and Child Nutrition Study Group. Nutrition-sensitive interventions and programmes: how can they help to accelerate progress in improving maternal and child nutrition? Lancet. 2013; 382(9891):536-51. doi: 10.1016/S0140-6736(13)60843-0.
7. IFAD. Improving nutrition through agriculture. Available from: http://www.ifad.org/pub/thematic/nutrition/nutrition_e_web.pdf[Cited 21 Sep 2015].
8. Action Contre La Faim and GRET. 2013. Sowing the seeds of good nutrition: making agricultural policies deliver better nutrition. Available from: http://www.actioncontrelafaim.org/en/content/seeds-of-good-nutrition[Cited 20 Aug 2015].
9. Burkina Faso. Politique Nationale de Securite Alimentaire et Nutritionnelle. Available from http://faolex.fao.org/docs/pdf/bkf141993.pdf[Cited 19 Aug 2015].
10. Fanzo J, Marshall Q, Dobermann D, Wong J, Merchan RI, Jaber MI, et al. Integration of Nutrition Into Extension and Advisory Services: A Synthesis of Experiences, Lessons, and Recommendations. Food Nutr Bull. 2015; 36(2):120-37. doi: 10.1177/0379572115586783.
11. World Bank. Fostering Agriculture-Nutrition links. Available from:http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2015/05/14/090224b082e7cf7f/1_0/Rendered/PDF/Fostering0agri0lum0reforms0in0India.pdf[Cited 05 Sep 2015].
12. Matourkou Agriculture Training Centre. Official website. Available from: http://www.capmatourkou.bf/[Cited 21 July 2015].
13. Freistadt F, Branigan E, Pupp C, Stefanutto M, Bambo C, Alexandre M, et al. A framework for revising preservice curriculum for nonphysician clinicians: The Mozambique experience. Educ Health (Abingdon). 2014; 27(3):283-8. doi: 10.4103/1357-6283.152190.
14. Sodjinou R, Bosu WK, Fanou N, Déart L, Kupka R, Tchibindat F, et al. Nutrition training in medical and other health professional schools in West Africa: the need to improve current approaches and enhance training effectiveness. Glob Health Action. 2014; 7:24827.
15. Dimaria-Ghalili RA, Edwards M, Friedman G, Jaferi A, Kohlmeier M, Kris-Etherton P, et al. Capacity building in nutrition science: revisiting the curricula for medical professionals. Ann N Y AcadSci. 2013; 1306:21-40. doi: 10.1111/nyas.12334.
16. Krebs NF, Primak LE. Comprehensive integration of nutrition into medical training. Am J ClinNutr. 2006; 83(4):945S-950S.
17. Sodjinou R, Fanou N, Deart L, Tchibindat F, Baker S, Bosu W, et al. Regional Nutrition Working Group. Region-wide assessment of the capacity for human nutrition training in West Africa: current situation, challenges, and way forward. Glob Health Action. 2014; 7: 23247.
18. Feldacker C, Chicumbe S, Dgedge M, Augusto G, Cesar F, Robertson M, et al. Mid-level healthcare personnel training: an evaluation of the revised, nationally-standardized, pre-service curriculum for clinical officers in Mozambique. PLoS One. 2014; 9(7):e102588.