



Vegetables in the coffee forest

The Yaju Biosphere Reserve in southwestern Ethiopia is located in a biodiversity “hotspot”. The diversity of native plants and animals in this region is very high and at the same time in danger of being lost. Over 90 percent of the local population are smallholder farmers who mainly grow coffee under the shade of the forest trees. Coffee, as a cash crop is the most important source of income. Its cultivation is supported by the government, as is the cultivation of starchy staple foods while micronutrient-rich foods such as fruit and vegetables do not receive much attention. Due to long transport routes and the perishability of fruit and vegetables, they are hardly purchased from other regions. Despite governmental subsidies for coffee, agricultural land is expanding further and further while coffee forests are being pushed back. In addition, more lucrative crops such as chat, a light drug that requires sunny areas for cultivation, are also expanding. The integration of vegetables in the coffee forest would add one more economically viable layer of cultivation in the forest that could help to increase forest conservation.

The objectives of integrating vegetables into coffee forests are to diversify and intensify cultivation and thus to improve nutrition, and to protect biodiversity.

The incorporation of new plant species into a cultivation system requires a multidisciplinary team that takes care of the individual project components.

Nutrition-sensitive agriculture in Ethiopia

The NutriHAF project

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The project investigates the introduction of vegetable species that have so far been sparsely used in a coffee-growing region in southwestern Ethiopia. The aim is to diversify the cultivation system in order to achieve a more diverse diet.

In Ethiopia, both production and consumption of vegetables and fruit are at a very low level and the recommended daily intake of 400 grams (WHO 2003) is far from being achieved. In general, Ethiopians consume 70 grams of vegetables and almost four grams of fruit

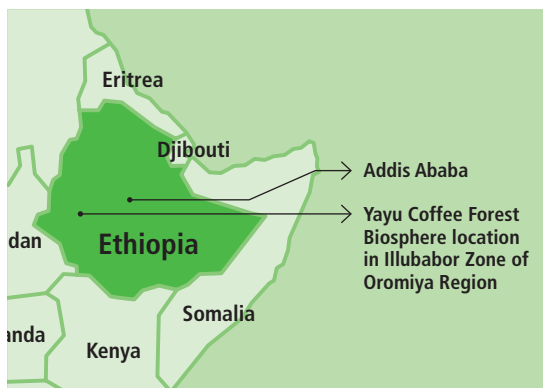
per person per day (Ruel et al. 2005). In order to meet the population's requirements of (micro-) nutrients, more support for nutrition-sensitive agriculture is essential. This is shifting the focus away from the production of calories towards the micronutrient content (e.g. vitamins and minerals) in food, especially fruit and vegetables.

Nutrition-sensitive agriculture (Jaenicke, Virchow 2013)

The concept of nutrition-sensitive agriculture aims to reduce and, if possible, close the gap between food that is available and food that is necessary for a healthy and balanced diet. All elements of a value chain are taken into account, starting with the provision of inputs (seeds, water, fertilisers and pesticides, etc.), through production, processing and storage of the food to retail and consumers. The focus is on nutritional aspects. The use of food is central. Aspects related to health, education and the environment as well as social and economic aspects must also be taken into account.

Project component 1: Selection of suitable vegetable species

Based on a literature study and focus group discussions with smallholder farmers and agricultural advisors in Ethiopia, nine vegetable species and one fruit species were selected using a range of criteria. Cultivation experiments were carried out with six species. The preliminary trials (2016) showed that cow peas (*Vigna unguiculata*) and pumpkin (*Cucurbita spp.*) as leafy vegetables grow well



in the shade. Therefore, these two crops were studied in more detail, in particular with regard to plant density of pumpkins and harvesting methods of beans. The experiments showed that a narrow planting density for pumpkin (25x25cm compared to 40x40cm) produces a higher leaf mass. This dense cultivation under coffee bushes is therefore recommended when intended to use the leaves (not the fruit!). In order to obtain the highest possible yield of cow pea leaves when growing under coffee, it is helpful to harvest the leaves individually at different times. Regular harvesting ensures that the bean plant neither climbs up the coffee bushes nor impairs their growth. This observation rebutted the initial fear of the farmers.

Once the leaves have been harvested, they must be processed rapidly because they spoil quickly. At the same time, there are possibilities to extend the shelf life of leafy vegetables, as was demonstrated by a master student of the NutriHAF project using the example of the Ethiopian cabbage.

Project component 2: Cultural conditions

The introduction of nutrition-sensitive agriculture could, in the case of an increased vegetable production and processing, also increase the workload of women who are traditionally in charge of vegetable gardening and food preparation. Therefore, it was proposed to involve men in vegetable production. This option was addressed in a role play. The analysis of working hours revealed that women work 8.5 hours a day on reproductive tasks in the household and an additional 3.2 hours on collecting wood and water. They work 11.7 hours a day, while men spend an average of seven hours a day on productive tasks, especially in the fields. Working hours in the garden are roughly the same for men and women. Both men and women are aware of the high workload of women; however, the majority of participants in the role plays had only few concrete ideas as to how the workload of women could be fundamentally reduced. Male participation in reproductive tasks is considered a cultural taboo. However, in the opinion of the participants, men should participate more in collecting wood and water as well as in the work in

the home garden. However, men's greater involvement in gardening work was not fully supported by the women due to fears that men would enter this sector primarily to generate income. The women would then no longer have control.

Project component 3: Nutrition education

The selected vegetable species were previously unknown in the region. On the one hand, this was due to agricultural advisors' focus on cash crops, and on the other hand due to the lack of governmental approval of, for example, amaranth seeds. Focus group discussions in mixed-gender groups in each project village revealed that there were only a few sources of information on healthy diets. Governmental health advisors counselled people in the first place on diseases and family planning. Nutritional knowledge and behaviour is primarily learned and passed on within the family. Trainings and further education measures related to vegetable cultivation and processing as well as nutrition and gender would therefore be useful for both, smallholder families and for the governmental advisors.

Employees in the NutriHAF project therefore designed a curriculum with six training modules. In addition to their own data from discussions with farmers and local agricultural and health advisors, the training modules are based on existing training concepts for nutrition-sensitive eating habits in Ethiopia (ACDI/VOCA 2016; USAID/Safe the Children 2012). The modules partly build on each other and include the topics of vegetable cultivation, processing and preservation, basic principles of nutrition, diversity in agriculture versus diversity in nutrition, plant health versus family health and plant growth versus healthy human development.

The aim of the training was to convey important basics of human nutrition using analogies from agriculture. Participants were enabled to transfer their existing agricultural knowledge to nutrition topics, for example by comparing the different needs for fertilization and care of crops at different growth stages with the different nutritional needs of humans in their development from baby to senior (ACDI/VOCA 2016). All parti-

Fact sheet

The NutriHAF-Project

The NutriHAF project: "Diversification of agriculture for a balanced diet: Fruit and vegetables in multi-level production systems" financed by the Federal Ministry of Food and Agriculture (BMEL), was carried out between 2015 and 2018 in Ethiopia and Madagascar. The Centre for Development Research at the University of Bonn coordinated the project in cooperation with the Ethiopian Climate Change and Coffee Forest Forum (ECCCF) and other institutes and non-governmental organisations in Ethiopia, Madagascar and Germany. A total of 10 postdocs and 35 master students investigated the introduction of fruit and vegetable plants into existing cultivation systems and their impacts on the nutrition of the rural population.

In Ethiopia, the project was implemented in the southwest of the country, in the Yayu Biosphere Reserve, one of the last forest areas with wild coffee. The reserve restricts any further expansion of agricultural land. This made a sustainable intensification of the existing areas necessary. The project budget amounted to 1.2 million euros.

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cipants completed a short questionnaire before and after the training. On average, only 45 percent of the 20 yes/no questions were answered correctly before the training, and 98 percent after the training. A poster was designed for each module and each vegetable species. In order to summarise the knowledge about the vegetable species (e.g. nutrients, cultivation re-



Women preparing Ethiopian cabbage leaves



At higher plant densities, the yield of pumpkin leaves is higher.

INTERVIEW

Geremew Chala studies in the Master's programme "Post-harvest Management" at the University of Jimma, Ethiopia. His master thesis is entitled "Post-harvest loss assessment and evaluation of the effect of packaging, handling and marketing conditions on the physicochemical properties of kale leaves (*Brassica carinata*)". Tim Schneider asked the questions.



Geremew Chala

How did you get to the NutriHAF project and why did you decide to write your master thesis as part of the project?

I came to the NutriHAF project through a master's thesis call that was posted on the Jimma University notice board. NutriHAF worked on several interesting nutrition issues. That is why I was very interested in making a contribution through my research.

What fascinates you about your master thesis topic and why is it important?

The reduction of post-harvest losses of leafy vegetables is very important for Ethiopia. I conducted research on the traditional Ethiopian cabbage, whose leaves can be bought in many markets almost throughout the whole year. The vegetables spoil more quickly if the leaf quality is already worse at the time of the harvest. Therefore, the processes for maintaining quality during production, harvesting, post-harvest treatment and marketing must be understood and taken into account as part of the same system. Many farmers know little about favorable post-harvest conditions, i.e. how cabbage should be stored and transported, and therefore often handle the harvest carelessly. In order to convince farmers of better transport and storage methods, the argument of a better market price can help. The central results of our study are that the time of harvest during the day, the packaging material, the type of transport and also the marketing conditions have a decisive influence on the quality of the leafy vegetables.

What do you think are the requirements for people in Yayu and Hurumu to eat more leafy vegetables?

An important condition is the preservation of the quality of the vegetables, so that they also look and taste appetizing. The vegetables should be harvested early in the morning, when it is still cool, and carefully transported. After harvesting or shortly before selling at the market, the vegetables should be placed in cold water for 30 minutes to prevent water loss due to heat.

How will you use your knowledge and experience once you have completed your Master's?

I will continue to use my knowledge for research and I will do my best to put my knowledge into practice. I will also share the knowledge and experience with other students at different scientific symposia and with people outside of science.

commendations and recipe suggestions), the project staff also created a "Vegetable Booklet". It is addressed primarily to the agricultural extension agents, who should increasingly incorporate the nutritional aspects into their advisory services. A double-page summary of all important information in tabular form can easily be copied and distributed to farmers and interested parties.

Project component 4: Dissemination of the new vegetables

The development and dissemination of recipes for culturally acceptable and tasty dishes is crucial for the consump-

tion of new vegetable species. This is especially true when the vegetables are either not known at all or are only known as cattle feed or weeds. The skillful combination of different ingredients can make vegetable consumption very appealing and optimises the supply of essential nutrients (*Chagomoka et al. 2014*). Recipes from the World Vegetable Center were adapted to the conditions in Ethiopia. In order to facilitate immediate replication of the new recipes it is important that the required cooking utensils are already available in the households and that the ingredients are readily available. Two nutritionists tested the recipes and adapted them again after a practical test phase

with ten families. Thereafter the dishes were prepared for a participatory tasting event.

At the first tasting event amaranth leaves, jute mallow leaves and pumpkin leaves were prepared in three different ways (with butter, with cow peas and with potatoes). For comparison, Ethiopian cabbage leaves were prepared in the same way. A total of 55 women and 47 men tried the dishes. Of the five possible categories (Likert scale), they selected only "tastes very good" and "tastes good". In a few cases there was a "draw", for pumpkin leaves also in several cases. The tasting of the cow pea leaves, prepared in three different ways (plane, with amaranth leaves and fish compared to Ethiopian cabbage and fish) showed a very similar result (39 female, 35 male tasters) (Refer to **Fig. 1**).

In both tasting events, no relationship could be established between the preference for a food and the sex, age, religion, education and origin of the testing persons. It was found that the new leafy vegetables performed just as well as the well-known Ethiopian cabbage, which served as a benchmark.

Outlook

In a variation of the proverb, the project was based on "tasting is believing": Only the tasting convinced the participants of the taste of the nutritious vegetables. The good taste of the dishes significantly increased the acceptance of the new vegetable species and the demand for seeds. In order to foster the cultivation of vegetables, processing and consumption, it is planned that the local agricultural extension agents will continue to provide trainings on cooking and nutrition while using the teaching material developed in the frame of the project. The material was also translated into the local language Oromifa. After the initial distribution of the seeds through the project, the farmers can now produce the crops by themselves and exchange them with each other (farmer-to-farmer). Round tables with local, regional and national decision-makers were organised to discuss the benefits of fruit and vegetable cultivation for food security and to promote appropriate policy measures.

Although the project is in its final phase, some questions remain unanswered:

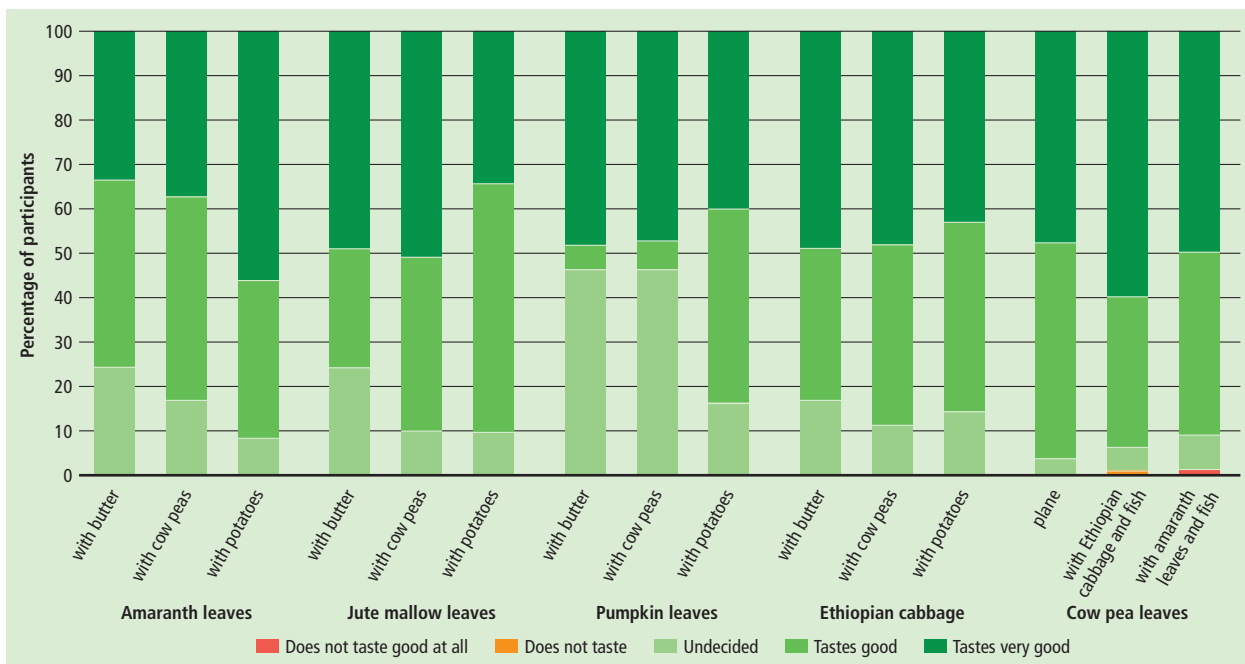


Figure 1: Results of vegetable tasting with 102 participants (amaranth leaves, jute mallow leaves, pumpkin leaves and Ethiopian cabbage) and 74 participants (cow pea leaves).

Will (additional) vegetable cultivation increase the workload of women? Will there be a local market for the new vegetable species? Will this generate additional income for households and especially for women? Will farmers use the shade in the coffee forest for the cultivation of the tested vegetable species or will they choose sunny arable land where higher yields can be achieved?

Many of these questions can probably only be answered after the end of the project, as local processes often take more time than the planned three years of a project cycle.



The tasting of the various leafy vegetables contributes significantly to their local distribution.

Literature

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