



Interactions between agriculture and nutrition in the African smallholder sector

Results and findings of the ADDA project

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important starting point for improving the nutritional situation of these population groups.

The “Agriculture and Dietary Diversity in Africa” Project (ADDA)

Although it has long been known that there are many interactions between agriculture and nutrition, many of them are still unexplored. In developing countries in particular, the nutritional situation is becoming increasingly complex because malnutrition, overweight and obesity coexist. Accordingly, the overall aim of the project was to better understand the complex interactions between agriculture and nutrition in the African smallholder sector and to improve local food security.

The project included two research components:

1. **Analysis of secondary data** from four African countries to identify factors affecting the nutritional quality of smallholder households. The results of the analysis are shown in **Overview 1**.
2. **Experimental approaches** towards investigating the extent to which agricultural extension improves the situation in Kenya's smallholder farming sector and how it can be supplemented by nutritional advice in order to promote nutritionally relevant innovations.

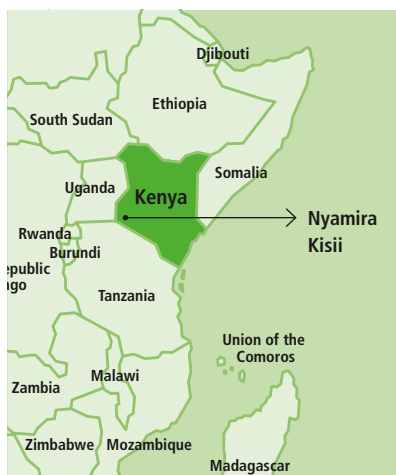
This second research component is described in more detail here.

The randomised field experiment in Kenya

Agricultural extension plays an important role in the spread of new agricultural technologies. Compared to other

An agricultural advisor informs a women’s group in Kisii about the black bean variety KK15.

The ADDA project - Agriculture and Dietary Diversity in Africa - examined the complex interactions between agriculture and nutrition in the African smallholder sector. In addition to the analysis of secondary data from four different African countries, a field experiment was conducted in Kenya to test new agricultural extension approaches. According to the results, the combination of agricultural and nutritional training are a promising driver for nutritional innovations.



Undernourishment and malnutrition cause considerable health problems and economic losses. Since nutritional deficiencies inhibit early childhood development, those affected will never be able to fully exploit their potential performance capacities. Also later in life health problems can occur due to the undersupply with important nutrients. These restrictions have consequences for those affected but also for the productivity of the society as a whole. In Africa, smallholder families are particularly affected by hunger and malnutrition. Accordingly, the agricultural sector is an

continents, the use of technology in Africa is still rather limited. Especially, this applies to smallholder farmers, who make up the majority of the rural population in Kenya and produce most of the locally consumed food. New technologies are needed to keep farmers competitive and secure their incomes. Reasons for the hesitant use of new technologies are manifold. The primordial reason lies in the lack of access to information on new seeds, improved technologies, prices and relevant market trends. Agricultural extension aims to create this access to information in the smallholder farming sector.

Currently, agricultural extension in Kenya has varying degrees of success. It is offered by government agencies and non-governmental organisations. In the past, individual farmers were advised, who were then to pass their knowledge on to others as multipliers. However, group trainings in one central location became increasingly popular as they are cheaper than visiting a larger number of small farms which are often far apart and difficult to reach where infrastructure is lacking. Therefore, many farmers were brought together to form groups in order to participate in development projects and agricultural trainings.

Study area

The randomised field experiment took place in Kenya in 2016, in the counties of Kisii and Nyamira in the western part of the country. These counties are densely populated; more than half of the population depends for their livelihood on agriculture. Most of the farms are very small: on average, a farming family cultivates less than one hectare of land. Small field sizes and a rapidly growing population lead to high pressure on land and yield, accompanied by overexploitation and impoverishment or leaching of the soil. Smallholders mainly grow maize, beans, plantains, tea, sugar cane and a number of local vegetables, often all together in one field. The nutritional situation in Kisii and Nyamira ranges in the Kenyan average. About a quarter of the children are too small for their age, which is mainly due to nutritional deficiencies. At the same time, one third of women are overweight or obese. Micronutrient deficiency is widespread in children and adults regardless of body weight.

The study design

The field experiment aimed at developing different advisory approaches and at testing their effects. Two very different technologies (food sources) were the subject of the experiments:

- The **KK15 black bean variety**, which has a significantly higher iron and zinc content than beans traditionally grown in the region and which also offers good yield potential. KK15 was developed by the public Kenyan Agriculture Research Institute using conventional methods.
- **Kuroiler chickens**, a robust dual purpose breed for egg and meat production. Kuroilers are less susceptible to diseases than conventional hybrid breeds.

The farmers were able to buy the seeds for the beans and the chicks at a subsidised price. Supplying these inputs free of charge would not have been favorable with regard to sustainability and appreciation. The project specifically focused on examining the deliberate decision of farmers to use specific technologies in light of different advisory approaches.

The various advisory approaches were developed and implemented in coope-

ration with the non-governmental organization *Africa Harvest* who has already acquired experience with projects in Kisii and Nyamira. In the ADDA experiment, the type of training modules varied to test which combination of information influenced the decision to use the technology most. Three interventions took place (**Fig. 1**).

Intervention I

Those small-scale farmers who had been randomly selected to participate in the first intervention were able to take part in nine agricultural advisory units. They learned about the characteristics of both technologies and about practical aspects regarding their use (e.g. sowing, fertilization for KK15 beans and stable construction, rearing, feeding of Kuroiler chickens).

Intervention II

Those small-scale farmers who had been randomly selected to participate in the second intervention received the same agricultural advisory units and three additional nutrition-specific training units. They learned about the basics of a balanced diet (e.g. clear expla-

Overview 1: Factors influencing the dietary diversity in smallholder households

The ADDA project's first research component examined the relationship between agricultural production diversity and nutrition in African smallholder households. A significant proportion of the food produced by small-scale farmers is intended for home consumption. It is therefore widely assumed that more diversified production can improve the quality of nutrition in smallholder households. However, research results gained by ADDA show that this assumption is not always true.

Dietary diversity is particularly important for the supply of vitamins and trace elements. The number of regularly consumed food groups is therefore often regarded as an indicator of the nutritional situation in a household. The project used available data from over 8,000 smallholder households in Ethiopia, Malawi, Kenya and Uganda to investigate the relationship between diversified production and dietary diversity. The analyses show that even though there is a positive correlation in many cases, the effects are predominantly small and decrease with increasing production diversity. On average, small-scale farmers would have to produce ten additional species to increase dietary diversity by a single food group.

The main reason for the small impact of more diversified cultivation is that small-scale farmers do not live exclusively of their own products, but also earn income through selling them. Too much diversification in production counteracts the economic advantages of specialisation. Given that small-scale farmers also purchase food, lower income means less money for higher quality food groups such as fruits, vegetables and animal products.

The results from Kisii and Nyamira in Kenya underline that better market access and sales of agricultural products do have a more positive impact on nutrition than does more diversified production. Hence, improving market access for small-scale farmers needs to be an important component of development projects aiming at food security.

Intervention 1	Intervention 2	Intervention 3	Control group
<ul style="list-style-type: none"> • Agricultural advice (9 units) 	<ul style="list-style-type: none"> • Agricultural advice (9 units) • Nutritional training (3 units) 	<ul style="list-style-type: none"> • Marketing training (3 units) • Agricultural advice (9 units) • Nutritional training (3 units) 	<ul style="list-style-type: none"> • No advice

Figure 1: Setup of interventions I to III

nation of food groups) and the functions of important micronutrients (e.g. vitamin A, zinc and iron). Training content was communicated interactively by means of posters. In addition, handouts were distributed which contained the most important information (Fig. 2).

The agricultural advisors also carried out the nutrition training. They had previously attended a three-day seminar with the ADDA team's nutritionist. The study examined whether agricultural advisors can effectively communicate nutritional information and influence farmers' innovation behaviour positively. Especially innovations not primarily intended to increase income, but rather to improve nutrition, could thus gain appreciation.

Intervention III

The randomly selected small-scale farmers participating in the third intervention received agricultural advice plus nutrition training and marketing training. This included two units on basic market contexts and a meeting with traders of beans, eggs and chickens to discuss the market potentials. The various training sessions took place in groups, participation was voluntary. Spouses were invited to participate in the nutrition training sessions. A total of 48 farmers' groups took part in the experiment. They had been randomly selected from a list of 170 groups in the region. Each intervention group consisted of twelve of those groups, while the remaining twelve constituted the control group. Group size varied between 20 and 38 small-scale farmers.

Data collection

A total of about 800 households, 15 to 20 selected randomly from each intervention group, took part in the survey. The first data collection took place from October to December 2015, while the first advisory interventions happened between March and September 2016. A second set of data was collected between October and December 2016, after the interventions were completed (Fig. 3). The registered member of the farmers' group was the main interviewee and answered a standardised household questionnaire which consisted of three elements:

- **24-hour recall protocols** of three individuals in the household (two adults and one child under five years of age)

FAMILY AND NUTRITION GUIDE

Art by Sam Kioko

Take Home Messages

- A healthy eating plan has three mixed meals a day
- Eat starchy foods with every meal
- Eat plenty of vegetables and fruits every day. Eat at least one portion of food from green leafy vegetables. Cook vegetables not for a long time.
- Eat beans (KK-15) or soya most days.
- Include animal and milk foods when you can, like Kuroiler chicken or eggs.
- Add some oil or have avocado or nuts at least once a day. This should be with the meal that has vitamin A rich foods. Drink a lot of clean water.

Maintain good hygiene at all times!

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Healthy Family Meals...

- Should contain a variety of vegetables and fruits, which provide plenty of micronutrients and fibre.
- Each family should be encouraged to use several food groups at different meals as different vegetables and fruits contain varying amounts of different nutrients.

Figure 2: Handout for nutrition training

Fact sheet: The ADDA Project

Through the ADDA project (Agriculture and Dietary Diversity in Africa), the Federal Ministry of Food and Agriculture (BMEL) funds a project that aims to improve knowledge about the complex relationships between agriculture and nutrition at the micro-level. It is jointly implemented by the University of Göttingen and the University of Nairobi and the non-governmental organisation Africa Harvest.

The project duration is three years (2015-2018). During the project, six doctoral students were trained, three at the University of Göttingen and three at the University of Nairobi. The budget of the project was around 850,000 euros.

- **7-day recall protocols** at household level (answered by the person in charge of cooking in each household)
- **Anthropometric data** of two adults and one child under the age of five

The questionnaire also included modules for collecting agronomic and socio-economic information as well as a social network section. During the second round, information on participation in the trainings and the decision on technology use (beans or chicken or none), was also collected.

Another questionnaire collected data on the farmer groups (e.g. history, function, frequency of meetings, training session, purchase of seeds or chickens, etc.).

First results

Small-scale farmers generally accepted the offered trainings well (Fig. 4). 70 percent of farmers in the intervention groups participated in at least one training unit. In addition, they attended on average 40 percent of the possible training units.

Results by the example of KK15 beans

In a first step, the “Intent-To-Treat” (ITT) effects were analysed. These measure how effective the intervention was for those small-scale farmers who belonged to the corresponding intervention group. The explicit aim was to measure the effect that the advisory service

had – irrespective of the actual percentage of people participating in the training units.

The ITT effects show that providing intensive agricultural advice in groups effectively contributes to adopting nutrition relevant technologies. Compared to the control group, intervention group I has a 23 percentage points higher likelihood of using KK15 beans (Fig. 5).

An additional offer of nutrition training in Intervention Group II further increases the probability of technology use. Apparently, agricultural extensionists convey nutritional information effectively and can thus influence innova-

tion behaviour positively. The additional marketing training in Intervention III does not seem to have had any additional effect in this case.

In a second analytical step, “Treatment-on-the-Treated” (TOT) effects were calculated. The TOT effects evaluate the effect the training has had on the farmers who actually took part in the training. For Intervention I, the ITT and TOT effects are identical. For interventions II and III, however, there is a clear difference: TOT effects are higher than ITT effects. Actual participation in the training has a greater impact on technology use than the mere offer being available (Fig. 5).

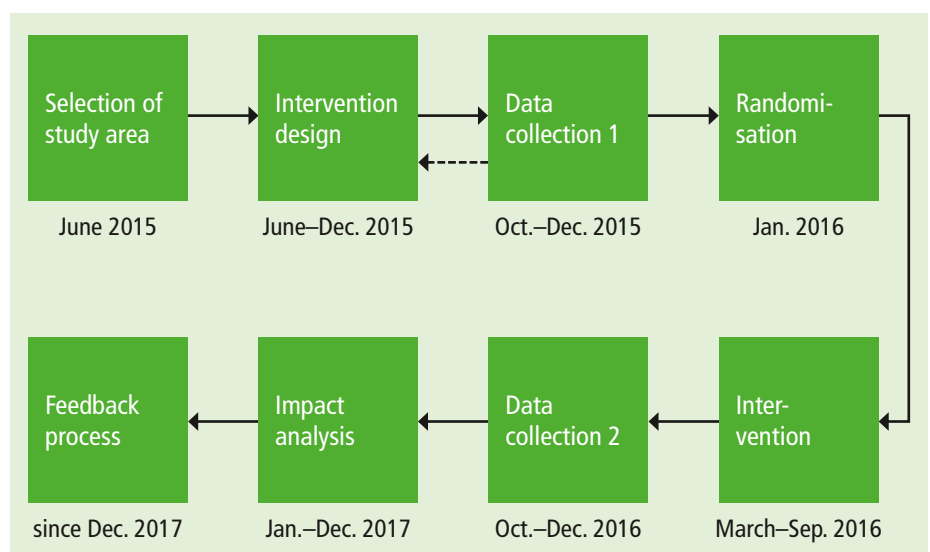


Figure 3: Schedule of the field phases in the ADDA project

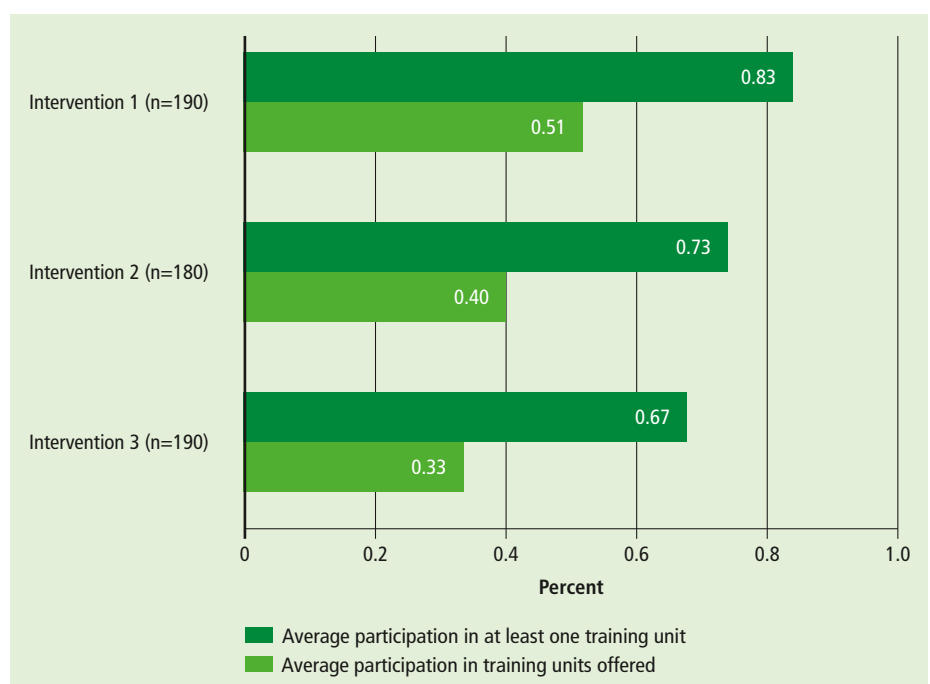


Figure 4: Participation in the offered trainings according to intervention

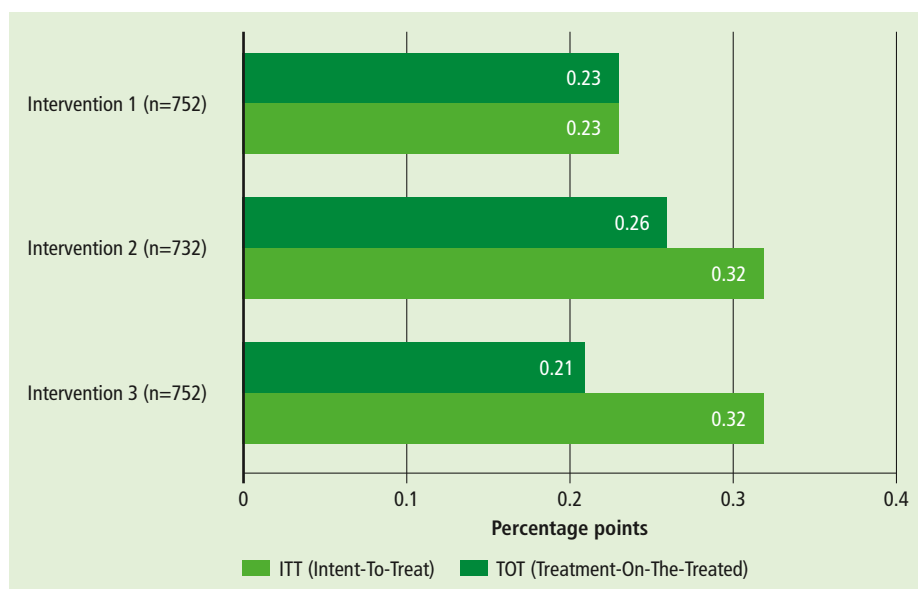


Figure 5: Effectiveness of ADDA interventions based on ITT and TOT effects

Participation in nutrition training seems to be more important than participation in agricultural training units. This can be explained by network effects: Within farming groups and through informal channels, agricultural information spreads more easily than nutritional information does. Farmers can therefore benefit indirectly from agricultural advice even if they have not participated in a training themselves. This informal exchange seems to apply less to nutrition information. Further analyses of social network data underline that group dynamics play an important role for the adoption and use of new technologies.

The decision of other farmers within one's own group substantially influences one's decision: the more people decide to cultivate KK15 beans, the higher the likelihood of individuals opting to plant this new bean variety themselves.

Preliminary results

These results demonstrate the importance of working with well-functioning groups and that group training is not only cheaper than individual advice, but also promotes positive group dynamics. The available data will be further analysed to answer additional questions,

for example with regard to the use of Kuroiler chickens and the effects of the trainings on the nutritional situation of smallholder families.

Conclusions and outlook

The ADDA project has shown that it can be promising to combine agricultural advice with trainings on nutrition in order to promote nutrition relevant innovations in the smallholder sector. Both disciplines have rarely been combined so far, given that agricultural advice, nutrition and health often fall within the competence areas of different organisations. Closer cooperation in the planning and implementation of projects is needed in order to better exploit synergy potentials. This is of particular relevance, given the complex food and nutrition related problems in developing countries. Nutrition-related topics should be integrated into the professional training of agricultural advisers. They could thus use their influence to sensitise farmers about important nutritional issues. ■

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Anthropometric data was also collected during the field work.



FOR THE TEAM OF AUTHORS

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