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Vegetable Gardening as a Hands-On Approach of Education for Sustainable Development – from an Educational Program to System Change

A case study of Acker

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Abstract

The global production and consumption of food contributes to a wide range of environmental and societal problems such as climate change, biodiversity loss, or health problems. In high-income countries such as Germany consumers lack an understanding of and connection to the origins of food which is one of many reasons for an unsustainable food system. Including in kindergartens and schools, many children do not learn how food is produced.

Acker is a social start up that fosters the appreciation of food and nature in society through a variety of educational gardening programs in Germany, Switzerland, and Austria. In the programs for schools (*GemüseAckerdemie*, engl. vegetable academy) and kindergartens (*AckerRacker*, engl. garden rascals) children grow up to 30 different types of vegetables. The gardening follows the principles of organic agriculture which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. Over the course of one year, children directly experience where their food comes from, taste the freshly picked vegetables, cook and/or sell it to their parents or to their school/kindergarten. The programs and accompanying educational materials are designed following the criteria of Education for Sustainable Development (ESD). Acker supports schools and kindergartens with the set-up and implementation of the learning garden over a period of four years. A train-the-trainer program is a key element to empower teachers and their institutions to implement the program independently after the four years and integrate it into their curricula in the long-term.

By 2030 Acker's goal is to give every child in Germany the opportunity to grow their own vegetables in school or kindergarten which corresponds to about 15,000 educational facilities. So far, participating facilities scaled exponentially from 6 facilities in the pilot phase in 2014 to 1,284 facilities in 2022. Acker's transformation strategy tightly couples its social business model with a marketing and impact strategy. The educational programs are regularly evaluated to understand the effectiveness of the intervention regarding motivational, cognitive, and behavioral change of the participants. Overall, the programs increase and strengthen children's connectedness to nature and appreciation of food. The gardening strengthens the children's sense of responsibility and self-efficacy both of which are necessary competences to participate in shaping a sustainable future. Growing and harvesting their own food also has positive effects on children's diet. Children try new vegetables and eat more vegetables both directly in the garden as well as at home. Yet societal transformation toward more appreciation for food and nature cannot be achieved just within the formal education system in schools and kindergartens. ESD needs to be implemented throughout different social systems. In addition to programs for schools and kindergartens, Acker is also establishing gardening programs for families and communities such as businesses, neighborhoods, or urban farming initiatives. Together with other ESD initiatives and programs, Acker aims to create a network of integrated, complementary ESD touchpoints that involve both formal and informal educational opportunities for people of all ages and diverse backgrounds.

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1. Introduction

Fewer and fewer children in Germany know and understand the connection between our natural resources and our food (Koll & Brämer, 2021). Consumers in general do not know where their food comes from and how it is produced. This is due to several factors: lack of value attribution, lack of education and lack of experiences with the natural world. Supermarkets offer any food from all around the world regardless of local seasonality. In addition, prices do not reflect the true cost of food. Environmental, economic, and social costs of food are externalities that are not included in the price that consumers pay. Our current food system uses far too many resources during cultivation, processing, transportation, and consumption and thus causes a series of environmental problems such as climate change, biodiversity loss, or contamination of surface and ground water (Campbell et al., 2017). Food waste is an expression of the disconnection from and low appreciation of nature and food. In Germany, about 12 million tons of food are wasted every year, i.e., about 75 kg per capita. About half of that food is thrown away in private households (Schmidt et al., 2019). Food waste contributes largely to global hunger as well as environmental problems such as climate change (Flanagan et al., 2019). Only about 2/3 of produce grown reaches the consumer's plate. This overproduction will cause greenhouse gas emissions from agriculture to at least triple by 2050 (Noleppa et al., 2015, Hic et al., 2016). Our food consumption not only leads to environmental problems but is linked to health issues as well. In industrialized countries a growing number of people consume unhealthy diets that cause malnutrition, including overweight and obesity, and lead to diet-related illnesses such as diabetes, cardiovascular diseases, and arthropathy (Meier et al., 2015). In Germany, this problem starts at an early age: more than 15% of children and adolescents ages 3 to 17 are overweight, almost 6 % are obese (Schienkiewitz et al., 2018). Only 14 % of children ages 6 to 11 and adolescents ages 12 to 17 eat the recommended daily allowance of vegetables (Robert Koch-Institut, 2018).

Acker is a social enterprise that is dedicated to increase appreciation for food and nature in society and tackle three main social problems: (i) alienation from nature and food production, (ii) food waste, and (iii) unhealthy diets. The vision of Acker ties in with the vision of the Food System Economics Commission “to support, globally and locally, the transition towards healthy, inclusive and sustainable food systems”¹ and support the achievement of the United Nations Sustainable Development Goals (SDGs), in particular “no hunger” (SDG 2), “health and wellbeing” (SDG 3), “quality education” (SDG 4), “sustainable consumption and production” (SDG 12), and “life on land” (SDG 15). Acker does so by offering different educational programs for children and adults, that are designed around sustainable vegetable gardening to create unique experiences with nature and food. With the organizational and educational support from Acker, schools and kindergartens establish a learning garden where children grow their own vegetables. The garden provides a natural environment for the children to directly experience sustainable food production and consumption. They learn about the labour and resources needed to produce vegetables and thus establish an understanding about the true cost of food. Theoretical knowledge is linked with hands-on experience which has been identified as a prerequisite for impactful learning (Franken, 2014). In schools, garden activities and accompanying educational materials are tied into the existing curricula of natural and social studies.

¹ <https://www.foodsystemeconomics.org/>

Education for sustainable development (ESD) aims to empower every human being with the knowledge, skills, attitudes, and values that are necessary to shape a sustainable future. Food production and consumption is one of many important topics in ESD. However, ESD in general and education about our food system in particular are not a common topic of the formal education system in Germany. Implementation in schools is scarce and inconsistent depending on *Länder*² regulations and the individual disposition of school directors and teachers (Holst & Brock, 2020). Most teaching methods do not include an experience-based approach that is needed for a deeper understanding and appreciation of societies' dependence on nature for present and future livelihoods. School gardens used to be a standard in German schools and curricula. During the educational reform in the Federal Republic of Germany in the 1960s, however, the school garden was eradicated from the curriculum for over 20 years. In the German Democratic Republic, on the other hand, the school garden remained an integral and obligatory part of school education from grade 1 to 4 until the 80s. Today, Thuringia is the only federal state that still has school garden as a subject in the standard curriculum. Not only can we observe a lack of formal education in this area but also decreasing informal opportunities to experience and interact with our natural environment (Louv, 2008). Yet studies show that nature experiences are a prerequisite to establish positive relationships with nature (Pensini et al., 2016; Soga et al., 2016; Rosa et al., 2018). Nature experiences and positive emotional relationships to nature during childhood foster pro-environmental attitudes and behavior in adulthood (Chawla, 1998; Chawla, 1999; Clayton & Opatow, 2003; Gebhard, 2009). Lohr & Pearson-Mims (2005) found the greatest effect in active gardening. Schools and kindergartens are ideal learning environments to foster healthy habits and impart to children the knowledge, skills, attitudes, and values that are necessary to shape a sustainable future. Throughout their formal education, children spend a lot of time in kindergarten and school. Interventions in these areas can therefore reach a diverse group of children independent of their socio-economic backgrounds. Formation of preferences and attitudes, for example regarding food, start in early childhood (Ellrott, 2007; Gätjen, 2020) which is why Acker's programs start already at the kindergarten level.

This case study describes Acker's transformation strategy from the pilot phase in 2014 to the envisioned system change in 2030 with a focus on the well-established outdoor gardening program *GemüseAckerdemie* (engl. vegetable academy) for schools. We present how impact orientation is the guiding principles in all areas of Acker's operations: the educational model, program development, funding, and implementation. We discuss key factors of our current success and challenges going forward toward system change within our education system and present policy recommendations.

2. The social enterprise Acker

Acker is a social enterprise that operates in a manner according to the definition of the European Commission based on three key criteria: social objective, limited profit distribution, and participatory governance (COM, 2011). Acker's main objective is to have a social impact rather than make a profit for its owners or shareholders. Its vision is to create more appreciation for nature and food in society. To achieve this vision Acker provides unique educational experiences centred around vegetable gardening and food specifically designed for different target groups such as children, adults, or businesses.

² There are 16 federal states in Germany, called *Länder*.

Acker



Figure 1: The structure of Acker with its sub-brands. *AckerRacker* (engl. garden rascals) and *GemüseAckerdemie* (engl. vegetable academy) are the outdoor gardening programs for kindergarten and schools, respectively. *GemüseKlasse* (engl. vegetable class) is an indoor gardening program for schools. *Black Turtle* supports private persons to grow traditional seeds and *Ackerpause* (engl. gardening break) offers gardening programs to offices and urban farming initiatives.

Acker combines a non-profit organization, Acker e. V., and a for-profit enterprise, Acker Company GmbH (Figure 1). Acker e. V. as the main organization was founded in 2014. Acker e. V. first developed the vegetable academy for schools in 2014. In 2017, the vegetable academy was adapted for implementation in kindergartens for children ages 3 to 6. In 2019, Acker e. V. piloted *Black Turtle* - a program for private persons focusing on traditional seeds. Acker Company GmbH - founded in 2019 - develops and manages the business-to-business program *Ackerpause* (engl. gardening break). If the company's activities become profitable, future dividends are used for the non-profit organization. We call this model "Profit for Non-Profit". In 2017 and 2019 Acker spun off the model into Switzerland and Austria, respectively. Both Austria and Switzerland operate in an independent organizational form but closely follow the program implementation and quality standards developed by the parent organization.

Acker has a head office in Berlin, Germany, and regional teams in 5 designated regions in Germany. In the head office in Berlin, central teams provide expertise, processes, and tools to the regional teams in various areas such as logistics, communication, IT, or impact assessment. Regional teams are responsible for operational planning and controlling, acquisition, funding, and partner management, recruiting, networking, and promotion on a regional level. Regional teams oversee the implementation of the programs in schools/kindergartens.

3. The vegetable academy

3.1 Program design

The vegetable academy is specifically designed for children of grades 3 to 6 (ages 8 to 11) but can be easily adapted to younger or older children. Instructed by a teacher at the school, children grow up to 30 different types of vegetables in a learning garden over the course of the gardening season from March to November (Figure 2). The hands-on program teaches children how to grow, harvest, prepare and share food. They learn about the resources it takes to cultivate vegetables and learn how to maintain the garden sustainably. Children directly experience natural processes and ecological feedbacks such as the seasonality of vegetables, the effects of weather and pests on the growth of plants in the garden. Theoretical exercises guided by the teacher provide the opportunity

to reflect upon their experiences within larger ecological, economic, or social contexts as well as connect the practical knowledge with theoretical knowledge about plant growth and ecosystem processes.

In most cases, the garden is installed on the school compound or in the direct vicinity of the school. Children spend an average of 90 minutes per week in the garden. Lessons may take place during the normal school curriculum or in the school's afternoon program, depending on the school's organization. After the completion of the gardening season, the next class takes over the garden.



Figure 2: Left - Children in a kindergarten work in the learning garden. © Acker e. V. / Nadine Stenzel. Right - Children listen to garden stories in the learning garden © Acker e. V. / Katharina Kühnel

3.2. Pedagogical approach

The learning garden lends itself naturally to the pedagogical approach of ESD. ESD stands for an education that allows every human being to acquire the knowledge, skills, attitudes, and values that are necessary to shape a sustainable future. The aim of ESD is to empower individuals to reflect their own actions while considering their current and future social, cultural, economic, and environmental impact – both on a local and global level. ESD does not only aim at cognitive learning outcomes (such as knowledge and understanding interrelations) that are relevant for sustainable development, but also at affective components, such as values and attitudes, as well as skills and behavioral intentions (Gatti et al., 2019; Gebhard et al., 2015). Individuals should also be able to act in complex situations in a sustainable manner and to participate in socio-political processes so that their societies can move toward sustainable development (UNESCO, 2017). But competencies cannot be taught but must be developed by the learners themselves and are acquired based on experience and reflection (Weinert, 2001). ESD therefore requires an action-oriented pedagogy, that supports self-directed learning, participation and collaboration, problem-orientation, and links formal and informal learning.

The vegetable academy presents many opportunities for students to acquire ESD competencies (Schenke, 2018; Keßler, 2019). The concept of ESD shaping competencies (“Gestaltungskompetenz”) by de Haan (2008) comprises twelve sub-competencies. Sub-competencies such as the ability to participate in collective decision-making processes, the ability to participate in collective decision-making processes, and the ability to motivate oneself as well as others to become active are competencies that are fostered by the recurring gardening activities as a team. In the learning garden, children experience the necessity of teamwork as the garden cannot be successfully maintained by just one person. The planting, care, and harvest of vegetables necessitate the collaboration and joint decision-making of the participants. Throughout the program children

practice social skills, conflict resolution and problem-solving. The vegetable harvest is visual proof of the outcome of both the individual and the team efforts throughout the season which fosters self-efficacy. The practical experiences in the garden are linked with exercises on interdisciplinary and global topics including sustainable nutrition, biodiversity, or food waste. The lessons can help students to understand the complex feedbacks of sustainable development and motivate them to think about their own behavior and consumption. Learning in the garden may ESD shaping competencies such as the ability to gather knowledge in a spirit of openness to the world, integrating new perspectives or the ability to think and act in a forward-looking manner. The learning garden can be used for other classes as well. The garden can serve as a practical example in different contexts such as math exercises regarding crop yield, art projects drawing plants or as a showroom to anchor complex topics such as the relation between climate change, food production and consumption. Acker's educational material provides teachers with a multitude of interactive and interdisciplinary exercises such as experiments, group discussions, or role plays. To understand global food consumption, for example, students research the origins of different vegetables in the supermarket as a homework. In class, transportations routes are visualized using a world map. Students then discuss the environmental effects of produce that is produced in and transported from different countries compared to produce grown in the learning garden. Children's observations in the garden can also be used to initiate discussion, e.g., about food waste. Children may notice that vegetables harvested in the garden do not look like the normed vegetable selection found in the supermarket. Together, teacher and children can talk about how 'ugly' vegetables are being tossed by farmers and supermarkets and come up with alternative solutions. These examples illustrate how the learning garden provides a natural and practical space to transfer theoretical knowledge from books into real life and practice problem-solving.

3.3. Principles of sustainable gardening

Ecological sustainability is key for the management of the garden and the purchasing, production, and use of materials. The garden is managed according to the principles of organic agriculture, i.e., in an environmentally friendly and natural way. To protect soil, water, fauna and flora, no abiotic substrates, hybrid and genetic engineering, artificial fertilizers or synthetic pesticides are applied. Mixed cultivation, crop rotation, and a consistent mulching practice further strengthen the health of soil and plants. Materials needed for gardening and teaching are sourced locally or regionally according to ecological criteria. Acker uses heirloom varieties for seeds and seedlings, which are regionally produced and distributed whenever available. These sustainability guidelines are taught in all trainings for teachers and staff.

4. Institutional implementation

4.1. Pricing and funding

Pricing of the vegetable academy is based on a 4-year funding and training model. The costs for the program are 18.100 € in total for the four years. About 60 % of the program costs are paid by sponsors which are secured by Acker both centrally and regionally. Acker e. V. draws funding from a wide range of partners and sponsors. Altogether Acker has over 120 partners and sponsors including federal and state departments, foundations, businesses, prevention programs, and donations. The high number and mix of partners avoid dependency on a few single partners or a certain branch of partners. This strategy provides the organization with a diverse and thus solid financial basis.

The other 40 % of the program costs are paid as co-payments by the schools, i.e., 6,900 € for four years. Co-payment of schools is calculated based on the principle of solidarity. Schools that pay the full amount of co-payment enable lower costs for schools with less funds. Schools fund the co-payment from a variety of sources such as budgets for trainings, subsidies from foundations or the *Länder*, booster clubs, or parents' contributions.

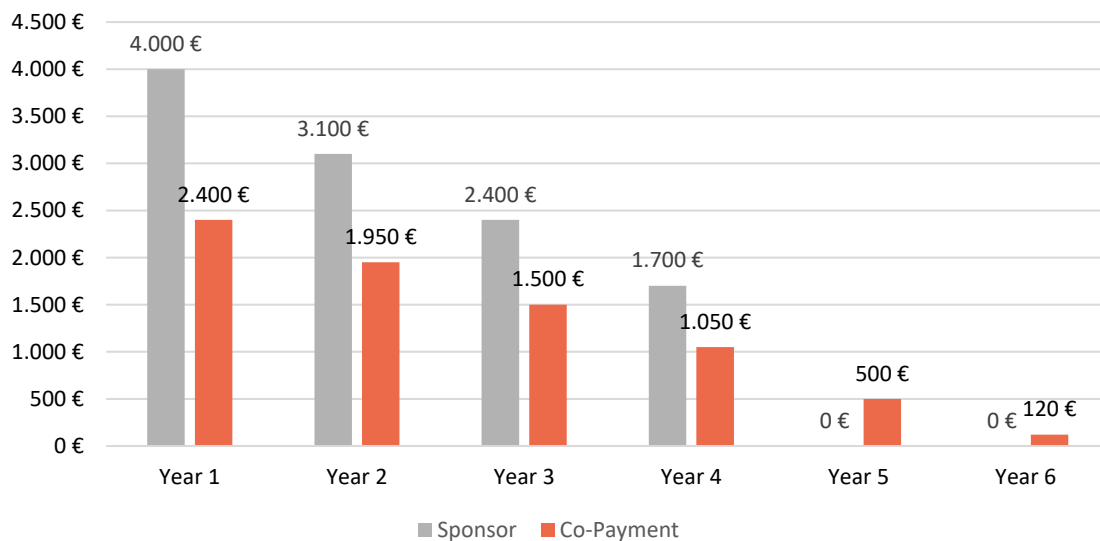


Figure 3: Program costs for the vegetable academy per year. Yearly costs show the ratio of sponsors in grey and co-payment by the schools in orange. Ideally, no external funding is needed anymore starting year 5.

Over the 4-year period teachers' knowledge and competences increase and they need less training and support by Acker. Program costs and necessary funding therefore gradually decrease. Ideally, program costs are at minimum after the 4-year period and no external funding is needed anymore (Figure 3). At the end of the gardening season in years 1 through 4 Acker staff and school personnel conduct a personal feedback interview to review the year and consult on the next stage. Although it is Acker's goal to maintain the 4-year model in most cases there are exceptions especially when the school can provide the full cost of the program. The most frequent challenge to the 4-year model are changes in personnel. When the well-trained garden teacher no longer conducts the program, a new teacher must take over. Acker therefore advises schools to have a team of at least 2 or more teachers trained at the start of the program at no extra costs.

In 2022 about 15% of schools operate independently after the 4-year program (Figure 4). With more and more schools arriving at this stage, the question is raised how quality standards regarding both garden management and teaching are being upheld without Acker's direct support. Acker is currently evaluating schools that garden autonomously to potentially revise support structures to help ensure quality standards.

Collaboration between the schools and Acker is regulated in a contract which can be terminated by the facilities on a yearly basis. The contract is upheld as an instrument of commitment even when the facilities are starting to work independently in their 5th year. At this stage, facilities pay for access to the digital learning platform with year-round gardening support and educational material. Additionally, they can book individual products such as consulting or seedlings at will (Table 1).

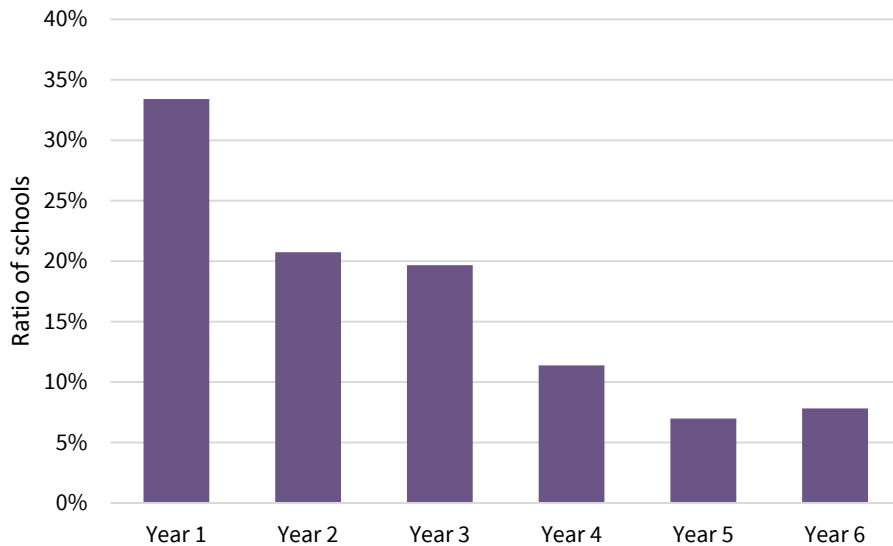


Figure 4: Ratio of schools (n=844) in the different stages of the 4-year program in 2022. Schools in year 5 or higher are implementing the program independently with minimum support from Acker.

4.2. Prerequisites and services

Acker provides a wide range of services to facilitate the installation of the garden and the implementation of the program at the school (Table 1 and Figure 5). In the first two years, services by Acker include consultation regarding the garden installment, delivery of seeds and seedlings, crop rotation planning, and support during planting season. Personal coaches with horticultural expertise manage the plantings on site. Schools need to provide the co-payment, space for the garden and a set of tools for the children. The main investment, however, is time. Teachers and staff need time to install the garden during start-up, plan the gardening lessons, tend to the garden, and attend necessary training, especially in the beginning. A 4-year train-the-trainer concept for teachers is a key element to empower teachers to implement the program independently and integrate it into their curricula in the long-term. Teachers can attend up to 3 seminars per year that offer basic and advanced training regarding horticultural knowledge and practices as well as ESD teaching methods. Basic training includes gardening techniques such as hoeing, mulching, or the care of the different vegetable plants. In advanced trainings, teachers are for example taught to harvest their own seeds and grow their own seedlings. Throughout all years, Acker provides digitized information to support teachers logistically, technically, and pedagogically throughout the gardening year via a weekly newsletter and a learning platform. The learning platform provides year-round support for teachers with gardening tips and educational materials such as background information, teaching methods, and students exercises.

Table 1: Acker Services provided for the program for years 1 through 6.

ACKER SERVICES	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6
Garden planning and management						
CROP ROTATION PLAN	X	X	X	X	X	X
SEEDS AND SEEDLINGS	X	X	X	X	X	-
PLANTINGS WITH PERSONAL SUPPORT BY A COACH	X (n=3)	X (n=3)	X (n=2)	X (n=1)	-	-
FEEDBACK INTERVIEW AT THE END OF THE SEASON	X	X	X	X	-	-
Seminars and expertise						
SEMINARS	X (n=3)	X (n=3)	X (n=3)	X (n=3)	-	-
PLANTING WORKSHOP	X (n=1)	-	-	-	-	-
PERSONALIZED WEEKLY INSTRUCTIONS	X	X	X	X	X	X
PERSONAL CONSULTATIONS	X	X	X	X	-	-
DIGITAL LEARNING PLATFORM	X	X	X	X	X	X

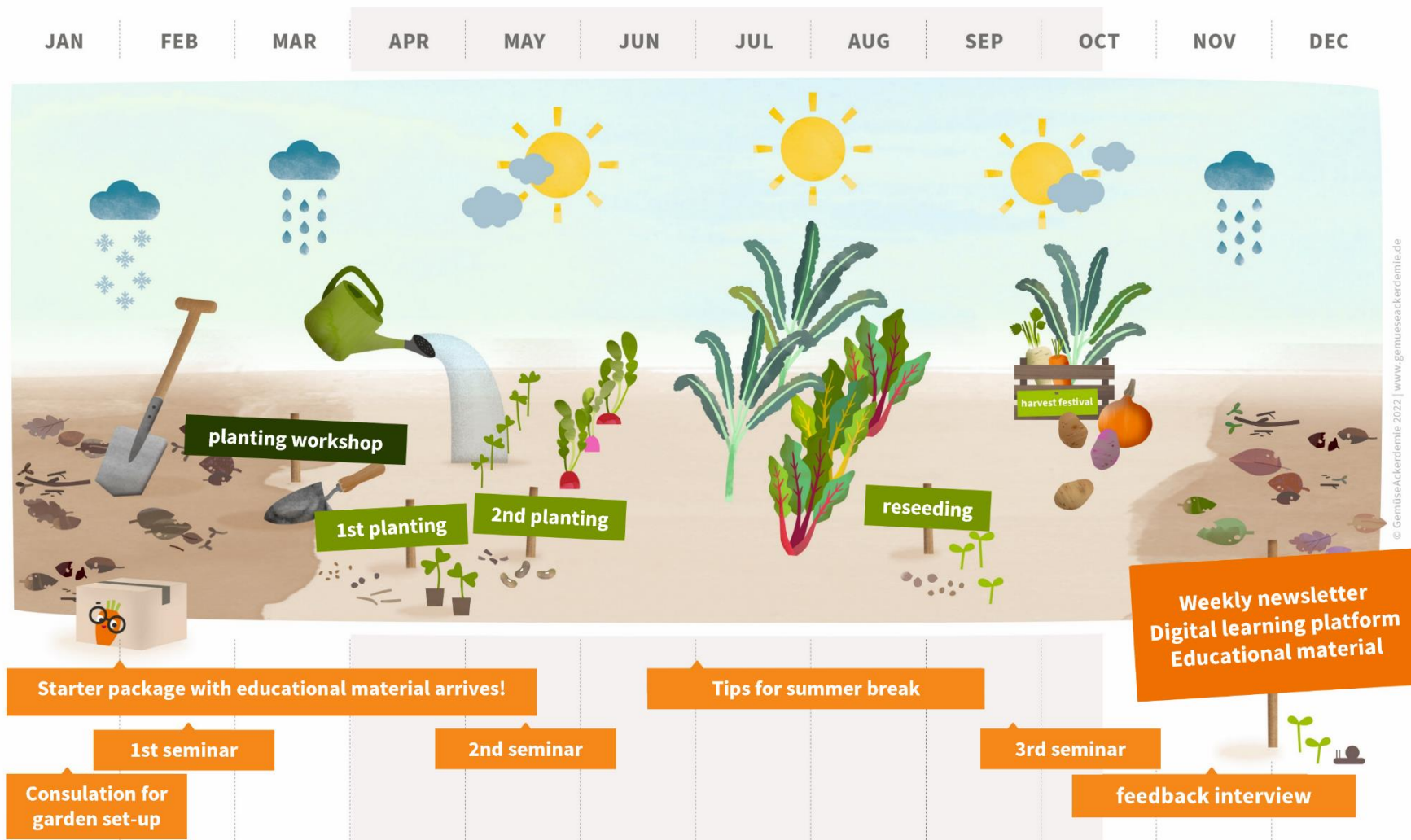


Figure 5: A year in the vegetable garden.

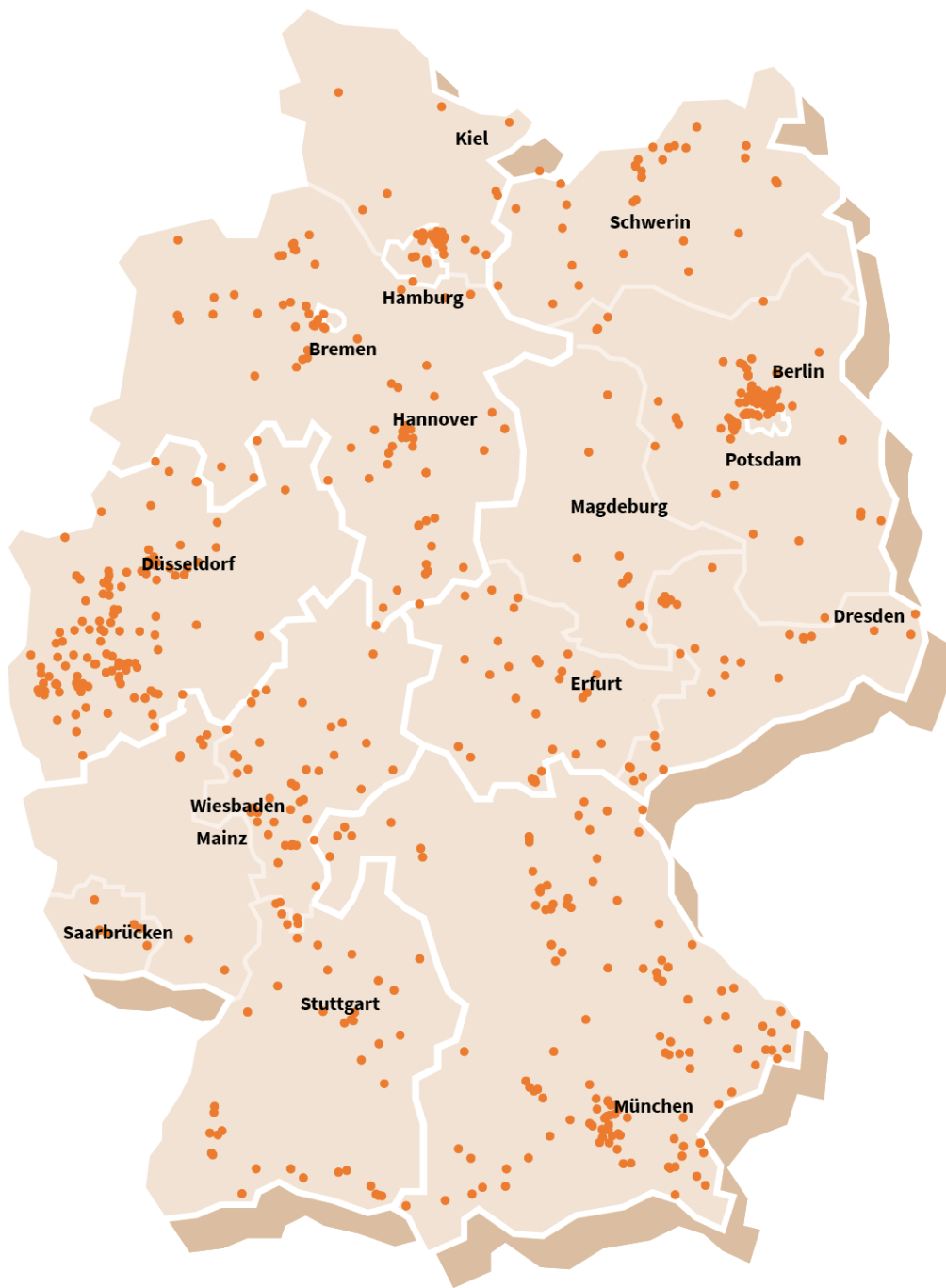


Figure 6: Locations of schools implementing the Acker programs in Germany (n = 875, December 2021). White boundaries show the operative regions of Acker in Germany.

4.3. Implementation

About 50 % of schools are located in urban areas and 50 % were located in rural areas³ (Figure 6). Most of the schools are public schools, with private schools only making about 3 to 5 % depending on the region. The actual implementation of the program is flexible and based on the wishes and possibilities of the institution. Schools decide on the size of the garden, the number and age of participating children, and whether the vegetable academy takes place as part of the obligatory school curriculum during the day or as a voluntary class during or after school (Table 2). The majority of schools are public elementary schools⁴ with participating students ages 6 to 11. In about 2/3 of the schools 2 to 4 grade levels are participating in the program. 40 % of the schools have made the vegetable academy part of their obligatory curriculum.

Table 2: Implementation of the vegetable academy in schools with regard to curricula, number of participating grade levels participating and ages of participating children in 2022. For about 26 % of the schools, no data was available regarding the curricular implementation.

Implementation characteristic	Percentage of schools
Obligatory curriculum	40 %
Voluntary curriculum	34 %
1 grade level participating	22 %
2 - 4 grade levels participating	66 %
> 4 grade levels participating	12 %
ages 6 to 7 (grades 1 – 2)	23 %
ages 8 to 11 (grades 3 – 6)	53 %
ages 12 to 15 (grades 7 – 10)	22 %
ages 16 to 18 (grades 11 – 13)	2 %

³ Urban and rural areas were designated according to the Thünen-Landatlas, edition 23/09/2022, Ed.: Thünen-Institut Forschungsbereich ländliche Räume, Braunschweig (www.landatlas.de)

⁴ German elementary schools include grade levels 1 through 4, except in the federal states Berlin and Brandenburg where elementary schools include grade levels 1 through 6.

5. Impact orientation and evaluation

Impact evaluation of Acker's programs has been a key area of business since the foundation of Acker. Acker orients the development of its programs to the target groups, such as children and teachers in case of the vegetable academy. Both development and evaluation use a participatory approach to create context-specific, concrete, and sustainable solutions, e.g., regarding the educational material or the digital learning platform. This strengthens the acceptance and commitment of the educational facilities and teachers to the program. Acker uses impact logics to connect impact goals with the used resources (input), the activities (output, see Chapter 0) and the envisioned change at the individual (outcome, chapter 0) and the societal (impact) level (Figure 7). The impact logic is a goal-oriented tool both internally and externally. Internally, the impact logic offers a clear understanding of the purpose of the organization and the program. Detailed goals and indicators for output and outcome allow for a well-directed and continuous program development and management. Each goal is SMART (Specific, Measurable, Achievable, Relevant, and Time-bound) and indicators are used to describe each goal. Goals and indicators help to continuously monitor the success of the program over time as well as check and improve the logics' underlying hypotheses. Externally, the impact logic offers transparency for partners, sponsors, and clients about resources employed, activities and goals of the organization. Results from the impact assessments are reported regularly for each program and published on the website (in German, <https://www.acker.co/WieWirArbeiten/Wirkung>).

SOCIETAL PROBLEMS

Our motivation

- alienation from agriculture and food: 30 % of all food are thrown away
- lack of contact to nature: loss of knowledge and competences regarding nature and food production
- unhealthy diets: increase in diet-related diseases like overweight and diabetes



INPUT

Our investment

- an interdisciplinary team
- expertise and experience
- networks
- material and financial expenses
- fun, motivation and passion

IMPACT

Our mission

- a society that consumes and produces in a sustainable manner
- more appreciation for nature and food
- implementation of healthy eating habits

OUTCOME

Our success

- Students:
- acquire knowledge of vegetable gardening
 - develop an interest and respect for nature and food
 - eat healthier

OUTPUT

Our program

- Students:
- grow their own vegetables over the course of one year
 - experience the relationship between nature



Figure 7: Impact logic of the vegetable academy.

5.1. Criteria for high-impact education programs

Acker has designed its programs for maximum impact based on four core criteria: (i) the installation of a nature-based learning space, (ii) implementation at schools, (iii) integration into school curricula, and (iv) provision of qualification measures for teachers.

A study commissioned by the German Federal Environmental Agency investigated the ideas children and young people have about the environment and nature and how they want to learn about these topics (Nachreiner et al., 2020). Several impact analyses in the fields of ESD, environmental education, and nutrition education have identified criteria for high-impact educational programs (Stiftung Mercator Schweiz & WWF 2013; Murimi et al., 2018; Rademacher & Heindl, 2019; WBAE, 2020; Renz-Polster & Hüther, 2016; de Haan, 2009; Baier, 1999). Both criteria for high-impact education programs and the demands of the target groups (Table 3) are fulfilled by the Acker program, complementing and specifying the core criteria.

Table 3: Criteria for high-impact educational programs.

Criteria
<ul style="list-style-type: none">• minimum intervention duration of 6 months• training of teachers• accompanying school garden lessons with additional educational materials specifically designed for the target group• action-oriented, situational, interdisciplinary, and problem-oriented learning• long-term implementation of the program at the educational facility• promotion of contact with nature as a basis for long-term nature behavior• learning spaces that enable experiences of self-efficacy• learning outside in nature and learning with movement as opposed to learning sitting in the classroom• experiments that allow children to acquire knowledge through trial and error and to use their senses such as touch and taste (e.g., harvesting vegetables, preparing food, building prototypes)• working and learning as a team

5.2. Evaluation methods

A mixed methods approach including both qualitative and quantitative methods is used to evaluate the vegetable academy (Table 4). Qualitative methods include group interviews with students and interviews with teachers and parents. Quantitative methods include standardized questionnaires with students and online surveys with parents and teachers. Evaluations are both conducted internally and externally. The external evaluation in 2015 was conducted by an independent contractor. In 2015, 2017, and 2018 internal evaluations were complemented by external evaluations in the framework of master's theses.



Table 4: Overview of evaluations of the vegetable academy from 2014 to 2022 with time of survey, outcome measures (IG = Intervention group, CG = control group), internal or external evaluation and reference.

Year	Time of survey	Outcome measures	Evaluation	Reference
2014	post	group interviews with students (n=92 in 4 schools); questionnaire with students (n=40); interviews with teachers (n=11); interviews with parents (n=4); online survey with parents (n=21)	external	Ackerdemia ⁵ , 2015
2015	post	3 participant observations; group interviews with students (n=72 in 3 schools); interviews with teachers (n=11); online survey with teachers (n=29); interviews (n=10) and online survey with parents (n=12)	internal	Ackerdemia, 2016
2015	pre/post (Mar/Nov)	questionnaire with students (n=202 IG, n=46 CG)	external	Nungesser 2016
2016	post	group interviews with students (n=144 in 6 schools); online survey with teachers (n=29); interviews with parents (n=22)	internal	Ackerdemia, 2017
2017	pre/post (Feb/Jul)	questionnaire (n=199 IG)	external	Drügemöller 2018
2018	post	online survey with teachers (n= 152); online survey with parents (n=52)	internal	Ackerdemia, 2019
2018	pre/post (Feb/Oct)	questionnaire with students (n=307 IG, n= 42 CG)	external	Klug, 2019
2019	post	group interviews with students (n=88 in 6 schools); interviews with teachers (n=9); online survey with teachers (n=226)	internal	Ackerdemia, 2020
2020	post	group interviews (N= 50 in 9 schools); interviews with teachers and school management (n=9); online survey with teachers (n=405)	internal	Ackerdemia, 2021
2021	post	questionnaire with students (IG n=171, CG n=82) online survey with teachers (n= 382); online survey with parents (n=167)	internal	Acker, 2022

In the first few years of the program, impact assessment focused on improving the program, tailoring it to the target groups and exploring potential pathways of outcome. In 2015, a pre-post

⁵ Acker was named Ackerdemia from 2013 to 2021.



study investigated the effect of the program on students regarding the alienation from food. A survey in 2017 used a pre-post questionnaire to investigate knowledge, attitude, and motivation of about 200 children participating in the program but did not include a control group (Drügemöller, 2017). Another pre-post survey in 2018 analyzed changes in the appreciation of food and connectedness to nature for both intervention and control group (Klug, 2019). In 2020 and 2021, impact assessment was strongly hampered by the COVID-19 pandemic as nationwide lockdowns prevented the regular implementation of the program. A survey in 2021 used a standardized questionnaire to analyze effects of the program on students' diets in comparison with a control group. The analysis showed no significant changes in student's diet which might have been due the ongoing limited implementation of the vegetable academy during the pandemic, the design of the questionnaire or both. During the pandemic many federal states restricted scientific evaluations in schools completely to reserve school time for core classes. To date (September 2022), those restrictions are still partially in place and pose a challenge for the extensive evaluation of the vegetable academy. In 2020, we investigated best practice schools and conducted interviews with teachers and school management as well as group interviews with former participants (1 to 3 years after the program) to explore long-term implementation and effects of the program.

Teachers present a reliable source of information about the students' academic and social development. In German elementary schools, most of the garden teachers are also the class teachers. Class teachers have the most classes with the children and therefore know each child very well. The outcomes for students and teachers presented in the following sections are based on the online survey conducted in autumn 2021 with teachers that participated in the program (Acker e. V., 2022). Teachers were asked to estimate whether students showed more appreciation for food, developed positive relations with nature, developed a deeper understanding of natural processes, started eating more vegetables or tasting new ones. Teachers estimated the ratio of student showing the specific outcome on a 6-step scale: "single students (less than 20%)", "less than half of the students (20% to 40 %)", "about half of the students (40% to 60%)", "more than half of the students (60% to 80%)", "almost all students (more than 80%)", and "I do not know". Reported percentages are a weighted average of all teachers' estimates in the survey assuming an average number of 25 students per class.

Teacher's observations were complemented with an online survey addressing the children's parents. Parents were asked among other things about the effect of the program on their families' food consumption. Both teachers' and parents' observations in 2022 continue to support the results of surveys with children from 2014 to 2020.

5.3. Output

The reach of the formal educational programs is described using two key performance indicators (KPI), (i) the number of participating educational facilities and (ii) the number of participating beneficiaries. Up until 2019, data collection for KPIs did not distinguish between schools and kindergartens. Here, we present numbers including both to better show the scaling of the programs.



Number of participating educational facilities

The vegetable academy was piloted in 2013 at one school in North Rhine-Westphalia. In 2016, 6 schools participated in 3 different states. By 2018, learning gardens were established in every German federal state as well as in Austria and Switzerland. In 2022, altogether 1,271 schools and kindergartens participate in the vegetable academy or the garden rascals, respectively (Figure 8).

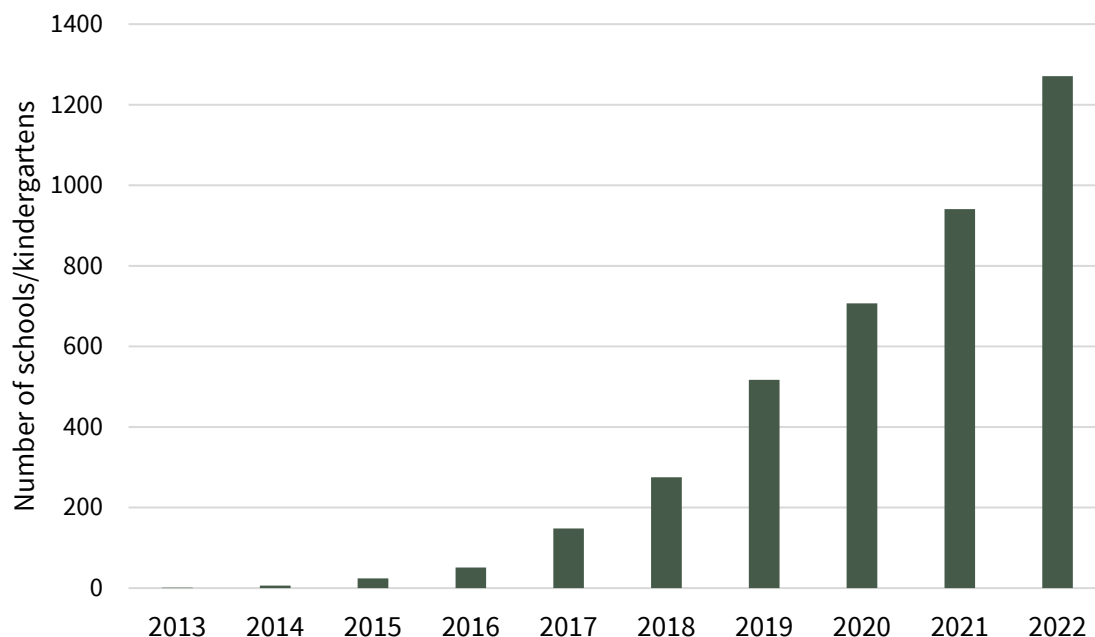


Figure 8: Number of participating schools and kindergartens per year from 2013 to 2022.

Number of participating beneficiaries

The main beneficiaries of the program are the participating children (Figure 9). Secondly, since the program includes a train-the-trainer program, teachers also profit directly from the program. Both their numbers increase with a growing number of participating educational facilities.

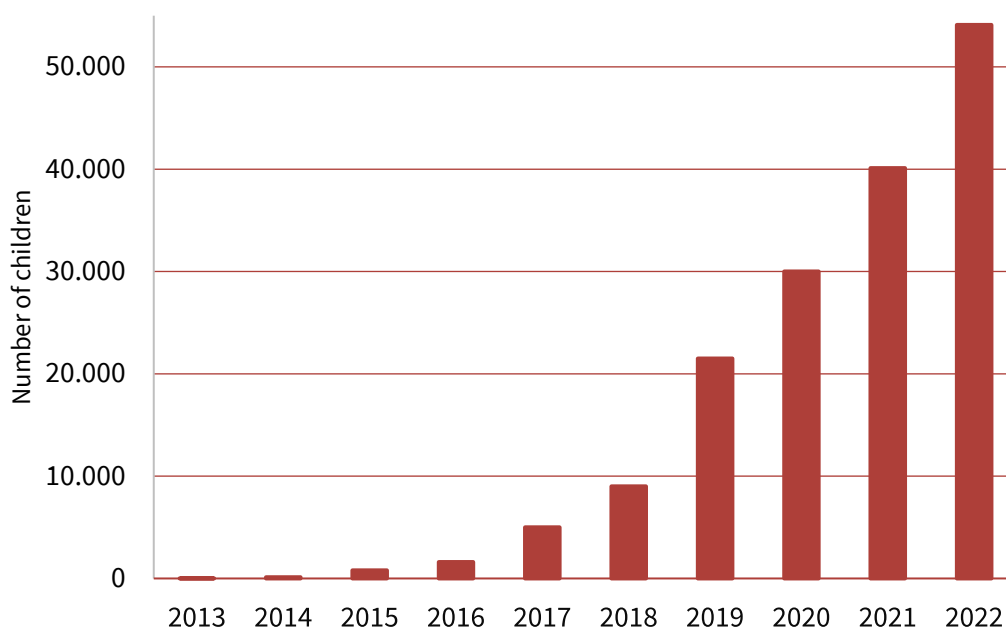


Figure 9: Number of participating children in schools and kindergartens per year from 2013 to 2022.

The more children of a school participate, the more impact can be achieved. Many schools start with one group or class of children in the learning garden and the size of the garden is planned accordingly. The spatial expansion of the garden may offer space for even more classes from different levels at the same time. This, however, depends on the available space at the school. Current educational material is targeted to grades 3 and 4. Acker plans to extend and adapt educational materials for younger (grades 1 and 2) and older students (grades 5 and up) to better serve these target groups. The impact can further be strengthened when the garden is used for interdisciplinary learning. Best practice schools show a great variety of examples from using the garden simply as a learning space in nature for any class, using the garden to teach other subjects such as math or art, to interdisciplinary projects on complex topics such as climate change (Acker e. V., 2021).

5.4. Outcome

The main outcome of the intervention is directed toward the participating children. Over the years we have identified several pathways that are relevant for the outcome of the intervention (Figure 10). A significant factor is the commitment of the children and the teachers. The children's competencies are imparted the design of the gardening lessons by previously trained teachers. The promotion of the children's competencies is significantly influenced by the interaction between the teacher and the child. For each target group like students or teachers we have defined outcome goals. The vegetable academy is specifically designed to generate outcomes in the areas of vegetable gardening, connectedness to nature, value attribution, and diet (Table 5) but also shows outcomes in the areas of responsibility or self-efficacy among others (Figure 11).

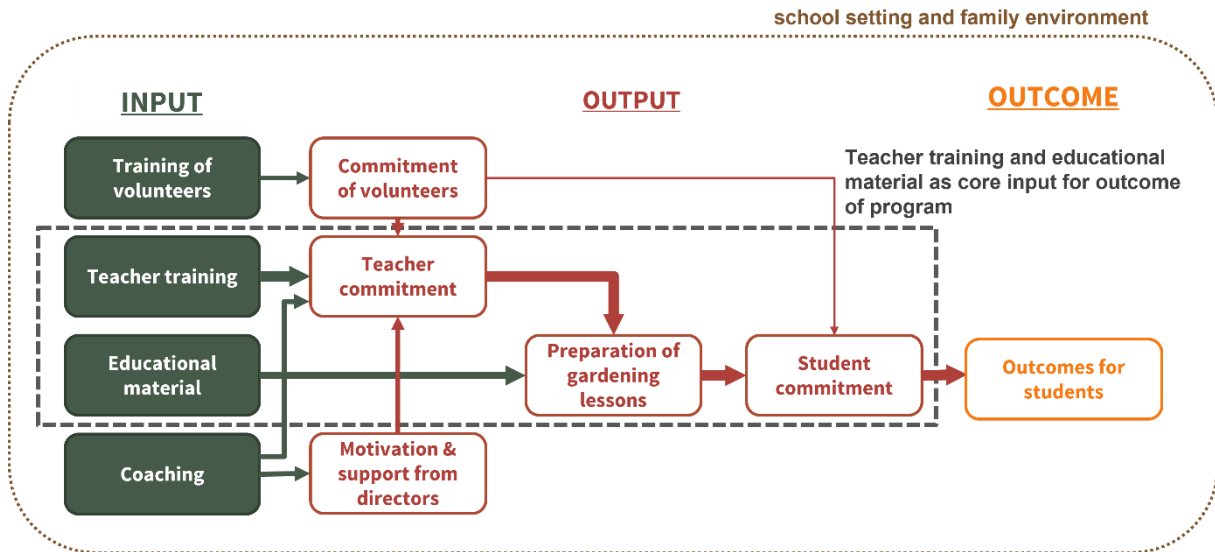


Figure 10: Outcome model of the vegetable academy. Thickness of arrows indicate effect strength. The dashed line frames the main pathways toward outcome.



Table 5: Outcome goals and indicators in main outcome areas for students.

Area	Goal	Indicators
Vegetable gardening	Students acquire gardening skills	Know how to name and use gardening tools; Know different garden activities such as sowing, planting, mulching etc.; Increase knowledge about vegetable types and varieties; Know the principles of organic farming; Know the seasonality of different vegetables
Value attribution	Students reflect consumer behavior	Reflect the difference between value and price of vegetables; Know the environmental effects of non-regional or non-seasonal vegetables
Value attribution	Students attribute more value and interest for vegetables	Know about the labor and resources necessary to grow vegetables; Want to take harvested vegetables home with them; Are curious to taste new vegetable types and varieties
Connectedness to nature	Students develop a positive attitude toward nature	Experience the time in the garden as positive; Reduce aversion or fear of nature (soil, insects, worms); Are interested in the natural processes in the garden
Connectedness to nature	Students develop an interest for and understanding of natural processes	Know what different vegetable plants need to grow; Know how plants grow from seeds
Diet	Students acquire food competences	Get to know new vegetable varieties; Taste vegetables directly from the garden; Cook meals with the harvested vegetables at home
Diet	Students increase their vegetable consumption	Try vegetables directly from the garden; Like vegetables better after the program than before; Eat vegetables that they did not like before; Eat more vegetables after the program than before



Figure 11: Outcome areas of the vegetable academy.

Outcome for students

Motivation and fun are key factors for any other learning outcome to take hold. Students are highly motivated to participate in the vegetable academy and mostly like working in the school garden. In a survey with over 300 participants, students rated the program with “very good” (on a scale of 1 – very good to 6 – very bad; Klug, 2019). Motivation stays high throughout the gardening season and students are sad to leave the program. Teachers especially notice a higher motivation and participation for garden lessons than for lessons in the classroom (Acker e. V., 2022). Throughout the program students discover the garden ecosystem with its agricultural crops, wild plants, beneficial organisms, and pests. They learn gardening techniques to successfully plant, care for and harvest vegetables in a sustainable manner (Drügemöller, 2017). Students get to know at least three new vegetable varieties on average and are more likely to taste unknown vegetables or even vegetables that they did not like before (Acker e. V., 2022). Teachers estimate that about half of the students (46 %) start eating more vegetables throughout the program and observe healthier snacks and lunch boxes in school. Parents also observe that the vegetable academy fosters healthier eating habits of their children and family (Figure 12).

Teachers estimate that about 65 % of the participating students develop more interest in vegetables and more appreciation for food. This is supported by another estimate of parents that observe the same effect for about 50% of the students. After the gardening season, students have a good understanding of the work and resources needed to produce food which increases its perceived value. Parents observe that their child “asks more questions about vegetables”, “does



not want to throw away leftovers“ or “only takes as much food as it will really eat“ (Acker e. V., 2022).

The gardening program also increases students’ self-esteem and self-efficacy for about half of the students. Over the course of the season, students become more confident and self-reliant in the garden activities and show increasing expert knowledge. About 58 % of the students develop a strong sense of responsibility for the garden and the plants. Commitment of students is high to take care of the garden after hours and during school breaks.

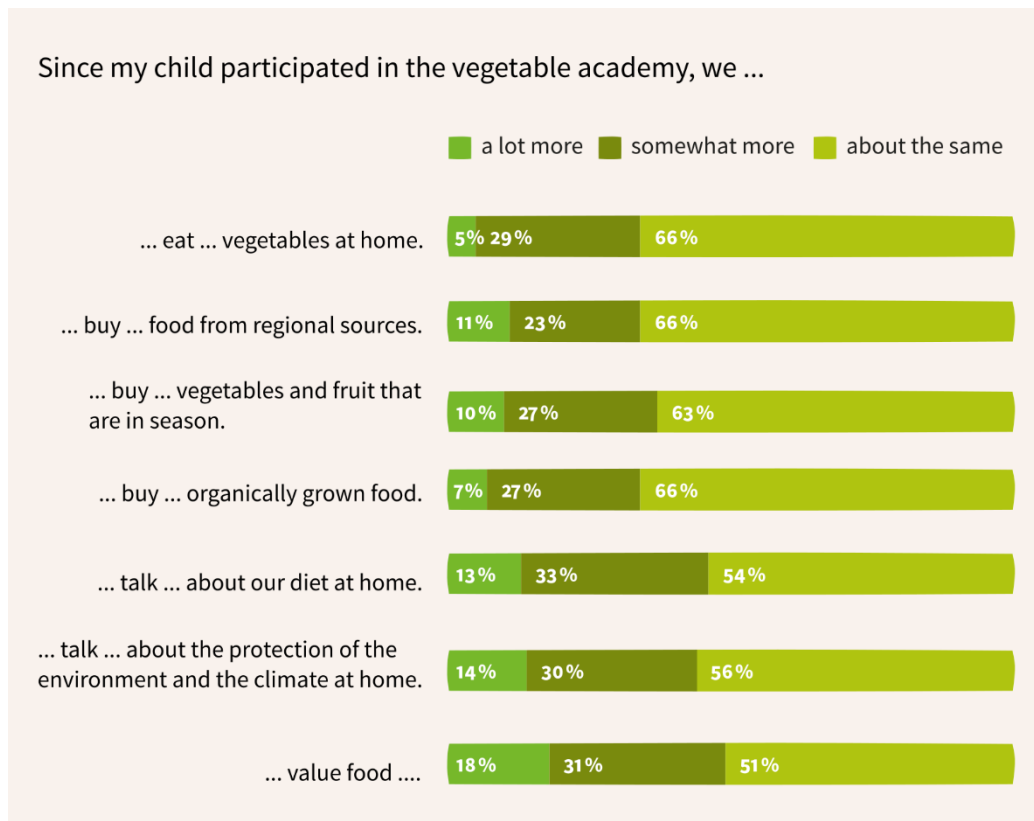


Figure 12: Outcome in the families of participating students (based on online survey with parents in 2021, n=167).

Outcome for teachers

Surveys also show positive outcomes for teachers. Gardening knowledge and skills increase for 89 % of teachers and 77 % of teachers get to know new vegetable types and varieties (Ackerdemia e. V. 2021b, Acker e. V. 2022). Teachers report a heightened awareness for food production and consumption. They value self-grown vegetables, throw less food away, buy food more regionally and seasonally, and eat healthier. The vegetable academy also enriches teachers’ work routine and teachers experience the work in the garden as a “joy” and “privilege” (Ackerdemia e. V. 2021b, Acker e. V. 2022). During the program about 75 % of the teachers get to know new methods and acquire new skills to teach children about nature and food (Acker e. V., 2022). Over two thirds of the teachers declare the gardening lessons their favorite part of their curriculum. More than half of the teachers report that student-teacher relationship improves with working in the garden



because of the teamwork and the opportunity to have more time to talk and bond with the children than in the classroom (Acker 2021, 2022).

5.5. Improving outcome analysis

Acker's surveys using standardized questionnaires show significant changes in students' knowledge about gardening, vegetables, and natural processes. They do not, however, show significant changes in self-reported attitudes and behavior regarding vegetable consumption or value attribution of food (Drügemöller, 2017; Klug, 2019). These quantitative results stand in contradiction to the qualitative assessments of students' outcomes or data collected by proxy from adults. Positive changes in value attribution and diet are observed by teachers and parents alike as well as in direct interviews with or direct observations of the children. It remains unclear whether this is due to lack of effect, or deficiencies in the study designs. Self-reported outcome from children, however, seem particularly unreliable. Children's cognitive, memory, communicative and social capacities are still developing. Children are also sensitive to social contexts and may be subject to different contextual influences from adults, such as a tendency to 'yay-say' or seek to please the interviewer (Bell, 2007). These circumstances make it especially difficult to design questionnaires that elicit good-quality quantitative data from younger respondents. This phenomenon is also observed in systematic syntheses of quantitative and qualitative evidence regarding the health and well-being impacts of school gardening (Ohly et al., 2016, Robinson-O'Brien et al., 2019). Qualitative evidence suggests that participants in school gardening programs (including children and adults) may experience and perceive a range health and well-being impacts, yet quantitative evidence remains limited. Both Ohly et al. (2016) and Robinson-O'Brien et al. (2019) stress the need for well-designed studies, especially for food intake. Parents report how the students' experiences and knowledge in the vegetable academy led to reflections of and changes in behavior regarding food consumption and diet. Yet, the effect of the vegetable academy on the diet of students and their families remains weak and not well researched over longer periods of time.

Observed outcomes can also be due to a variety of factors, not to the vegetable academy alone. This is especially true for dietary changes where a variety of factors such as family and peers influence the behavior in students (Hetzer et al., 2020). This outcome area has not yet been investigated within a randomized controlled trial, which would ascertain the effect of the vegetable academy to a certain degree. Assuming that the students' social and food environments remain relatively stable within the 1-year duration of the program, we estimate that most of the observed outcomes are largely due to the program. Overall, outcome reported for the vegetable academy is supported by peer-reviewed studies. Systematic reviews have identified positive impacts of school gardens on children's attitudes toward food, their eating habits, overall well-being and academic achievement, and attitudes toward the environment, with most of the evidence coming from the UK, USA, and Australia (Davis et al., 2015; Ohly et al., 2016; Savoie-Roskos et al., 2017). But long-term outcomes of gardening interventions beyond a study duration of 18 months have not yet been investigated. Acker's own impact assessment has focused on short-term effects immediately after the end of the intervention in October or November. Therefore, we cannot say how long the observed effects last. Explorative group interviews with



students 1 to 3 years after the program, however, indicate that the vegetable academy remains a strong memory and contributes to shaping student's actions. In collaboration with scientific partners, Acker is therefore developing appropriate study designs including both qualitative and quantitative measures and applying for funding to conduct a longitudinal study.



6. Transformation strategy: from upscaling to system change

Acker started to develop the vegetable academy for schools in 2013. After a proof-of-concept and evidence of impact, the social business model was developed and expanded to all German states from 2016 to 2018. In 2017 the program was adjusted for implementation in kindergartens. Acker is currently in the scaling phase (phase 3) of its transformation path (Figure 13). By 2024 Acker aims to reach 2,500 schools/kindergartens and by 2030, Acker aims to offer every child in Germany the possibility to experience a learning garden in kindergarten or school. This scaling strategy combined with the outcome of the program aims to contribute to a social shift towards sustainable agriculture, diet, and consumption. All business activities are oriented to achieve the social objectives of Acker and further increase its impact. Key elements that support the scaling and transformation strategy are digitization, decentralization, and teacher education.



Figure 13: Transformation phases of Acker.

6.1. Digitization

Digitization is a key element of Acker's transformation strategy creating scalable, cost- and time efficient operations. It concerns different processes from both the operational and the educational area. In the operational area, Acker uses Podio, a web-based platform to automate workflows regarding the on-boarding of new schools, customer journey management and administration, logistics to deliver educational materials, seeds, and seedlings, and evaluation of services. In the educational area, Acker provides digitized information in addition to the print material for students and teachers via a learning platform. From 2019 to 2021, the learning platform has been thoroughly revised and expanded to support teachers with two main features:



(1) **Personalized support throughout the gardening year**

The platform provides seasonally adapted information, tips, and tricks on gardening activities such as pruning or harvesting or challenges such as pests or plant illnesses. Information is customized to the individual school garden with varying planting times and crop selections.

(2) **Database of educational material**

A continuously growing database provides educational materials both for students and teachers. The material can be filtered according to topics (e.g., soil, water, plants), subject, grade level or *Länder* to facilitate integration into the curriculum.

The platform is a powerful scaling and transformation tool especially for schools. Technically, the platform is currently being adapted to host an active customer-journey management for teachers including booking and billing of services. This feature will increase efficiency and decrease costs of operational processes during scaling. With regards to content, the database can easily be extended in the coming years to include material for all ages and a greater variety of topics and subjects which will strengthen and broaden the (interdisciplinary) use of the learning. Information and materials in the database add on to the in-person trainings. E-learning programs as well as peer-to-peer consultations for teachers are being developed to further strengthen the motivation and learning curve of teachers and altogether increase the autonomy of the educational facilities.

6.2. Volunteer support networks

In the beginning, Acker recruited and trained volunteers to support schools in the installation and management of the garden. This approach, however, became too time- and cost-intensive with an increasing number of participating educational facilities. In 2020, Acker started a different approach. Acker's regional teams now support schools to build a strong school community to ensure long-term implementation of the vegetable academy. They encourage schools to find their own volunteers within their community such as other teachers, maintenance staff, older students or parents and grandparents. Volunteers can register with Acker and access the learning platform. They can also attend one preparatory workshop in the beginning of the gardening year, but further schooling is not provided.

6.3. Decentralization and regional development

The German federal education system allocates large legislative power and responsibilities to the *Länder*. This is the case for education issues but also for many other policy areas. Acker must be present on a regional level to reach its target groups, i.e., schools and teachers, but also to lobby at *Länder* level. Acker's regional teams are much more agile to respond the political agendas of the *Länder* with a customized lobbying strategy. They can work within regional and local networks to raise awareness about the impact of the vegetable academy. Regional offices are also better suited to apply for regional funding opportunities than the central office. In most of Germany's 16 *Länder*, the regional teams are in contact with relevant ministries, such as the ministry of education, agriculture, or environment. Communication about the program by government officials raises the respectability of the program and helps with the acquisition of new schools.



Political cooperation and engagement also take place on a municipal level. This is of particular importance since municipalities play a significant role for the implementation of the SDGs (German Federal Government, 2021). Supporting the vegetable academy means an investment in the future viability of the community. The mayor of the first county in Germany to invest in the program stated: “Many different players within the community worked together to start this gardening program. Students will now become environmental experts. There is no better way to raise awareness for sustainability in the next generation.” Schools benefit from a cooperation because they can promote their focus on environmental education. Municipalities benefit because the program involves its numerous members (i.e., educational institutions, families, local authorities, environmental initiatives, farmers), provides hands-on opportunities to engage in sustainable action, and in turn increase the value of the community.

Good local and regional networks are equally important for the scaling the program. In the beginning, it was crucial to identify relevant key communicators to inform teachers about the existence of the vegetable academy. These forums and networks are often regionally organized. Today, the gardening teachers themselves have become the best advertisers. They talk with their colleagues about the significant impact the program has on their students and the school environment and thus promote the acquisition of new schools. Regional networks are also important to recruit horticultural coaches who support the facilities with garden installation and planting in the first few years of the program. By now, Acker’s regional teams can build on their experience and cooperation with other environmental or ESD organizations and networks to promote work as a coach for Acker.

6.4. Teacher education

Hands-on nature-based learning in the context of ESD is not yet a standard method in schools which is largely due to a lack of training within teacher and pre-service teacher education. Well-trained teachers are essential to make ESD and nature-based learning spaces such as the learning garden an indispensable and standard element of schools. Motivated and well-trained teachers are likely to initiate systemic changes in the schools’ curricula and community (Ackerdemia, 2021a, 2021b). To strengthen teacher’s skills beyond the train-the-trainer program of the vegetable academy, Acker developed the *CampusAckerdemie* (engl. campus garden academy) in 2021. The campus garden academy is an educational program for university students. The program is integrated into the curricula of education departments and technical colleges for education to access future teachers. Like the vegetable academy, the campus garden academy teaches university students to set up and manage a school garden on their own and to integrate it effectively into everyday school life. The hands-on approach combines experiential learning, building horticultural expertise, as well as didactics and methodology of ESD. In 2022, 11 universities throughout Germany offer the campus garden academy as a new module in their education curricula.



7. Discussion

7.1. Success factors of Acker

Acker is an example of how a social business model can successfully create large-scale impact: a marketing and scaling strategy are coupled to combine the reach of the educational programs with the individual outcome for the beneficiaries such as students and teachers. All of Acker's organizational structures and processes are designed to maximize impact. In contrast to hierarchical organizational structures, Acker's main aim is to reduce overregulation and micro-management and to keep decision making agile and efficient. At the same time management focuses on employee's wellbeing and strengths-based development. Studies have shown that organizations supportive of the needs for competence, autonomy, and relatedness of employees maintain or enhance intrinsic motivation and facilitate the internalization and integration of extrinsic motivation (Deci & Ryan, 2000). Together, the type of management and organizational structure make Acker more flexible, creative, and resilient which are main reasons for Acker's rapid growth and successful scaling. In terms of scale, Acker's transformation strategy is working. Participating educational facilities scaled exponentially from 6 schools in the pilot phase in 2014 to 1,284 schools and kindergartens in 2022⁶. With supporting strategies and tools in place, such as the digital learning platform, Acker is likely to reach its goal of 15,000 schools and kindergartens in the DACH region by 2030. To achieve system change, however, both scale and outcome need to be ensured in the long-term. It is a common phenomenon that interventions are not made permanent after funding runs out even if they prove to be very effective. An analysis of 700 health measures in Germany showed that 39 % of the measures were conducted only once and only 10 % were permanently implemented (Büning-Fesel, 2020). Instead of being a one-time project, Acker purposely designs all its interventions as long-term programs: By empowering teachers to manage the garden independently, by catering to the special needs of teachers but also by aiming to change perspectives and motivation of key stakeholders at the educational facilities such as directors, teachers, parent representatives, or service staff and thus implementing the programs permanently in the curriculum. Co-payments are an important element to increase the commitment of educational facilities to the program. This also creates customer relations where Acker needs to cater to the needs of target groups, making the program custom-build. A low dropout rate of only 5 % reflects the high commitment of schools to the vegetable academy. Motivating teachers and school directors is key both to the implementation of the program as well as to obtain maximum outcome for the children.

Until now Acker has been successful to secure the necessary funding for the current full-service 4-year implementation model. However, the funding model might not be sustainable with further scaling to reach every child by 2030. Acker is starting to develop a modular gardening program that would allow more schools to participate in the program at lower costs. Increasing digitization and efficiency of many operative processes will be a main task to reduce costs. Reducing personal services such as coaching and in-person trainings would reduce costs but might also reduce

⁶ Acker status quo in July, 2022



outcomes. Balancing financial sustainability and outcome will be a major challenge for Acker in the future.

7.2. Garden education beyond Germany

The vegetable academy was designed for Germany, its specific social and economic situation and education system. Due to similar conditions, the program could be easily transferred to other German speaking countries such as Austria and parts of Switzerland with little to no modifications. Education about gardening and nutrition incorporates a magnitude of perspectives and possible approaches. Programs may range from individual school gardens to nationwide and institutionalized implementations. Many initiatives do not offer a comprehensive support and qualification structure (especially trainings, personal advisor, newsletter) and/or do not provide sufficient learning material. Whether those programs have less impact than the Acker programs, however, cannot be estimated due to the lack of comparable impact assessments. While the field of comparable initiatives in German-speaking countries is rather scarce, internationally there exist several initiatives who - to a smaller or greater degree - offer a product comparable to Acker. *Big Green* and *Green our Planet* in the USA and the *Kitchengarden Foundation* in Australia show similar (potential) scalability and program characteristics compared to Acker. As shown in Acker's impact logic, the vegetable academy provides a solution that is custom tailored to societal challenges that are common to high-income countries such as overweight or food waste. With similar programs in other countries showing successful implementation, the school garden program seems to be a possible standard for ESD in high-income countries. In low- and middle-income countries, however, different approaches are needed that address the specific needs such as food scarcity, chronic undernutrition, or lack of basic standard education. The Homestead Food Production (HFP) program implemented by Helen Keller International in Bangladesh, for example, trains women's groups in vegetable and fruit gardening, poultry rearing, hygiene, childcare, and nutrition. In HFP, the vegetable garden is one element of many to increase household access to and consumption of nutrient-rich foods and allow for more interesting and varied diets (Talukder et al., 2010).

7.3. Creating social impact: from motivation toward sustainable behavior

Especially children have a holistic, creative, and uncompromised view of the world which holds great potential to disrupt and initiate change (Überschär, 2022). Accessing and mobilizing this potential is part of Acker's mission. Studies show that children partake what they learn and experience at school with their families at home: they transmit knowledge and generate awareness. They can exert a strong disruptive power by introducing new concepts and ideas into their families and may even initiate behavioral change (Drummond, 2011; Böttcher & Jahn, 2014; Überschär, 2022). The power and degree of influence children can have, however, depends on the degree to which they are listened to (Überschär, 2022). Both the school environment and the families need to provide space for dialogue and democracy to support children's initiatives. Yet while children may stimulate reflection and change, it is not their responsibility nor their capability to transform the world alone. The individual outcome for children of a program such as the vegetable academy must also be viewed within the wider context of their food environment. Food environments may counteract individual motivation regarding healthy and sustainable food choices - either by no or limited options, or by counterproductive measures such as the promotion of unhealthy and/or unsustainable food. Shaping food environments to provide and foster



affordable, sustainable, and healthy dietary options is needed so that individual outcome can turn into action. This is illustrated in schools where the school garden provides knowledge and motivation to choose a healthier diet but is contradicted by school lunch that does not provide such a choice. In Germany, the Scientific Advisory Board on Agricultural Policy, Food and Consumer Health Protection (WBAE) of the Federal Ministry of Food and Agriculture therefore calls for kindergarten and school lunches in accordance with the quality standards of the German Nutrition Society (DGE) in combination with more action-oriented nutrition education (WBAE, 2020).

Societal transformation toward more appreciation for food and nature and behavioral change cannot be achieved just within the formal education system via children outcome. Acker envisions a lifelong learning path from kindergarten to high school and university, from childhood to adulthood as well as learning opportunities in different settings such as schools, private households, or urban gardening communities. In this vision, ESD is implemented throughout different social systems such as schools/kindergartens, families, neighborhoods, or businesses and anyone from child to adult can become a change agent. This is why Acker is continuously creating a broader spectrum of educational programs. In 2019, Acker initiated and founded two non-formal education programs. The gardening program for private households *Black Turtle* delivers curated seed packages focusing on vegetable diversity and forgotten foods. The (home) office gardening program *AckerPause* fosters teamwork and health at the workplace and brings urban farming to neighborhoods. At the same time, Acker is extending its collaborations to build broad coalitions between diverse ESD stakeholders. In this context, municipalities are powerful partners to establish a network of integrated, complementary ESD touchpoints that involve both formal and informal educational opportunities for people of all ages and diverse backgrounds.

7.4. Transforming formal education

The German Federal Government implemented steps to move ESD from *project to structure* to systematically integrate the concept into Germany's formal education system since 2015 (Nationale Plattform Bildung für nachhaltige Entwicklung, 2017). Yet, today no national education standards exist for ESD. The current school system in Germany is oriented toward academic performance and skills and do not center around ESD or other approaches such as global learning that focus on sustainable development. STEM (science, technology, engineering, and mathematics) education focuses on the training of high-performance specialists without consideration of sustainability aspects (Singer-Brodowski, 2019) although STEM skills are vital for future sustainable development. It seems obvious that future engineers should learn how to design technology that follows sustainability standards and promotes sustainable behavior. Yet up to date ESD and STEM education remain two separate areas.

The most basic competencies for sustainable development remain largely ignored in the German education system, i.e., contact to and respect for nature and the resources we live upon. Montessori schools and Waldorf schools are best practice examples of uniform, centrally organized educational standards and methods regarding school garden education. The love for nature is one of the main elements in the methodology of Maria Montessori which positively



affects the implementation of the vegetable academy at Montessori schools. Acker employees observe that Montessori schools in general show more motivation to implement the vegetable academy. All teachers are involved in installing and managing the program and students of all ages profit from learning experiences in the garden. Montessori schools are also much more flexible and open to permanently implement the vegetable academy in their curriculum. Curricula frameworks of the *Länder* vary strongly both in terms of ESD topics taught as well as in teaching time allocated. Teaching methods are even less well implemented varying between *Länder* and even between universities. 74 % of teachers in Germany deem their knowledge to teach ESD as insufficient (Brock & Grund, 2018). Acker's impact assessments have shown that teachers are crucial to the successful outcome of the program. The development of ESD competencies and skills by the children is directly linked to the design of the interaction between teacher and student ((Fukkink & Lont, 2007) and the teacher's motivation. Teachers can become role models for students as well as colleagues and staff in their educational facilities. Despite federal and state regulations, public schools and teachers do have a lot of freedom in designing lesson plans and school environments. With the vegetable academy, Acker supports schools to integrate ESD and school gardens into their school culture: incorporating garden activities into school curricula, empowering teachers through training, promoting best practice examples and networking with stakeholders. The campus garden academy for university students is Acker's attempt to provide standardized education to teachers and pre-service teachers regarding learning gardens and ESD. Together, the vegetable academy and the campus garden academy aim to build a generation of teachers that is motivated to initiate change in the German education system from the bottom-up.

7.5. Policy implications

By 2030, Acker envisions to offer every child in Germany a learning garden to initiate the process of system change and make ESD and learning gardens a standard in German formal education. For this system-wide change, however, Acker needs support on the state and federal level. Acker has recognized this challenge and is starting to lobby for systemic changes in the German education system. Acker is starting to work with the ministries of Education and Cultural Affairs of the *Länder* to implement school gardens in the education systems. First small successes are visible on the municipal and *Länder* level. The municipality of Munich passed a regulation that newly built schools need to allocate space for school gardens. In some *Länder*, such as Lower Saxony, a partnership has been established on a representative basis, i.e., the minister of education has become the patron of the vegetable academy. In others such as North Rhine – Westfalia, the ministry supports the vegetable academy financially. The actions and levels of support strongly depend on the political program of the governing party in the *Länder*.

Acker has identified three key policy recommendations for change in the education system:

- 1) Implementing hands-on sustainability and nutrition education in school curricula as an educational standard.
- 2) Installing high-quality nature-based learning environments in schools.
- 3) Implementing ESD and learning gardens in teacher training.



All three policy recommendations have the common goal to provide standardized, high-quality ESD within an action-oriented natural learning environment to today's children and adolescents. Sustainable development in general, sustainable food production, and nutrition need to be part of the curriculum as well as every-day practices in educational facilities. ESD is an interdisciplinary topic that needs to be incorporated in every subject. A natural learning environment like a vegetable garden allows students to experience nature, connect theory and practical experience and create a holistic learning experience. Like a gym or a computer pool, a natural learning environment should become a standard in every educational facility.

8. Conclusions

This case study of Acker and its impact assessment shows:

- Schools and kindergartens are ideal learning environments to foster healthy habits and impart children the knowledge, skills, attitudes, and values that are necessary to shape a sustainable future.
- Acker's gardening programs for schools and kindergartens show positive student and teacher outcomes that support the building of ESD competences, foster appreciation of food and nature and behavioral change regarding food consumption.
- A social business model coupled with a marketing and scaling strategy can create large-scale impact, coupling the reach of the educational program with the individual outcome for participants.
- Acker's transformation strategy is successful. Participating educational facilities scaled exponentially from 6 facilities in the pilot phase in 2014 to 1,271 facilities in 2022. 15,000 schools and kindergartens in the DACH region will very likely establish a school garden program in their facilities with the support of Acker by 2030.
- For more impact, standardized, high-quality ESD linked to action-oriented natural learning environment needs to become standard in school curricula and teacher education.
- Transformation toward more appreciation for food and nature in society and cannot be achieved just within the formal education system. ESD needs to be implemented throughout different social systems such as communities, kindergartens, or businesses. Broad coalitions between diverse ESD stakeholders are needed to create a network of integrated, complementary ESD touchpoints.
- Similar successful education programs in other countries suggest that Acker's concept is not limited in its success to merely Germany but can be implemented in other high-income countries.



References

- Ackerdemia e. V. (2021a). Wirkungsbericht AckerKita 2020. Berlin/Potsdam: Ackerdemia e. V. <https://cms.acker.co/canto-medias/document/p8ihutvgs95l9dvqdhdfro5i11/live>
- Ackerdemia e. V. (2021b). Wirkungsbericht AckerSchule 2020. Berlin/Potsdam: Ackerdemia e. V. <https://cms.acker.co/canto-medias/document/hm82k0nfsh06n263sthhc6k07n/live>
- Acker e. V. (2022). Wirkungsbericht GemüseAckerdemie 2021. Berlin: Acker e. V. <https://cms.acker.co/canto-medias/document/r96rc220kd0fvd29i3vah7aj5q/live>
- Baier, H. (1999). Die Schule im Schulgarten. Zum Verhältnis Umwelterziehung, Schule und Schulgarten. In H. Baier (Hrsg.), *Umwelt, Mitwelt, Lebenswelt im Sachunterricht* (Bd. 9, S. 15–32). Bad Heilbrunn: Klinkhardt.
- Bell, A. (2007). Designing and testing questionnaires for children. *Journal of Research in Nursing*, 12(5), 461-469.
- Böttcher, S., & Jahn, I. (2014). Ernährungsalltag von Familien in sozial benachteiligten Lebenslagen. *Prävention und Gesundheitsförderung*, 9(4), 247–252. <https://doi.org/10.1007/s11553-014-0459-9>
- Brock, A., & Grund, J. (2018). Executive summary - Bildung für nachhaltige Entwicklung in Lehr-Lernsettings - Quantitative Studie des nationalen Monitorings - Befragung von LehrerInnen. Berlin.
- Büning-Fesel, M. (2020). Was Projekte erfolgreich macht: Wege in die Verstetigung. In: Rademacher, C. & Heindl, I. (Eds.) (2019). *Ernährungsbildung der Zukunft. Maßnahmen und Wirksamkeit der Professionalisierung* (pp. 36 -43). Umschau Zeitschriftenverlag.
- Campbell, B.M., Beare, D.J., Bennett, E.M., Hall-Spencer, J.M., Ingram, J.S.I., Jaramillo, F., Ortiz, R., Ramankutty, N., Sayer, J.A. & Shindell, D. (2017). Agriculture production as a major driver of the Earth system exceeding planetary boundaries, *Ecology and Society*, 22(4), 1–11.
- Chawla, L. (1998). Significant Life Experiences Revisited: A Review of Research on Sources of Environmental Sensitivity, *The Journal of Environmental Education*, 29(3), 11-21.
- Chawla, L. (1999). Life paths into effective environmental action. *The Journal of Environmental Education*, 31(1), 15-26.
- Clayton, S. & Opatow, S. (Hrsg.), (2003): Identity and the natural environment: The psychological significance of nature. MIT Press.
- Communication from the Commission (COM) (2011). Social Business Initiative: Creating a favourable climate for social enterprises, key stakeholders in the social economy and innovation, European Commission. <https://www.fi-compass.eu/sites/default/files/publications/social-business-initiative-creating-a-favourable-climate-for-social-enterprises-key-stakeholders-in-the-social-economy-and-innovation.pdf>
- Davis, J. N., Spaniol, M. R., & Somerset, S. (2015). Sustenance and sustainability: Maximizing the impact of school gardens on health outcomes. *Public Health Nutrition*, 18(13), 2358–2367. <https://doi.org/10.1017/S1368980015000221>
- Deci, E. L. & Ryan, R. M. (2000). The "What" and "Why" of Goal Pursuits: Human Needs and the Self-Determination of Behavior. *Psychological Inquiry*, 11(4), 227-268. https://doi.org/10.1207/S15327965PLI1104_01
- de Haan, G. (2008). Gestaltungskompetenz als Kompetenzkonzept der Bildung für nachhaltige Entwicklung, in: Bormann, I., de Haan, G. (Eds.), *Kompetenzen Der Bildung Für Nachhaltige Entwicklung*.



Operationalisierung, Messung, Rahmenbedingungen, Befunde. Springer VS Verlag für Sozialwissenschaften, Wiesbaden, pp. 23–43.

de Haan, G. (2009). Potenziale der Umweltbildung zwischen Bildungsreform und virtuellen Welten. In F. Brickwedde & A. Bittner (Hrsg.), *Kindheit und Jugend im Wandel! Umweltbildung im Wandel?* (Initiativen zum Umweltschutz, Bd. 72, S. 34–42). Berlin: Erich Schmidt.

de Haan, G. (2010). The Development of ESD-related Competencies in Supportive Institutional Frameworks. *International Review of Education*, 56, 315-328.

Drügemöller, N. (2017). Wissenszuwachs und Einstellungsveränderung von Kindern durch die Teilnahme am Bildungsprogramm „GemüseAckerdemie“. [Masterarbeit, Universität Kassel]. Acker e. V.

Drummond, C. (2011). Using nutrition education and cooking classes in primary schools to encourage healthy eating. *Journal of Student Wellbeing*, 4(2), 43-54.

Ellrott, T. (2007). Wie Kinder essen lernen. *Ernährung*, 1(4), 167-173.

Flanagan, K., Robertson, K. A. I., & Hanson, C. (2019). Reducing food loss and waste: Setting a Global Action Agenda.

Franken, L. (2014). *Einfluss von Praxiselementen auf den Wissenszuwachs beim Thema „Gemüsepflanzen“ in der 6. Jahrgangsstufe* [Bachelor thesis, Bergische Universität Wuppertal]. Acker.

Fukkink, R.G. and A. Lont, Does training matter? A meta-analysis and review of caregiver training studies. *Early Childhood Research Quarterly*, 2007. 22(3): p. 294- 311.

Gätjen, E. (2020). Wie Kinder Essen erleben und erlernen. *Ernährung & Medizin*, 31, 81–89.

Gatti, L., Ulrich, M. & Seele, P. (2019). Education for sustainable development through business simulation games: an exploratory study of sustainability gamification and its effects on students' learning outcomes. *J. Clean. Prod.* 207, 667–678.

Gebhard, U. (2009). Kind und Natur: Die Bedeutung der Natur für die psychische Entwicklung (überarbeitete und erweiterte Auflage) GWV Fachverlage GmbH. 313 Seiten.

Gebhard, E., Hagemann, N., Hensler, L., Schweizer, S. & Wember, C. (2015). Agriculture and food 2050: visions to promote transformation driven by science and society. *J. Agric. Environ. Ethics* 28 (3), 497–516.

German Federal Government (Ed.) (2021). *German Sustainable Development Strategy. Update 2021*. German Federal Government.

Hetzer, L. (2020). Die Entwicklung von Kompetenzen für ein nachhaltiges Ernährungsverhalten von Kindern. Master thesis, Humboldt Universität zu Berlin.

Hic, C., Pradhan, P., Rybski, D. & Kropp, J.P. (2016). Food Surplus and Its Climate Burden. *Environmental science & technology*, 50(8), 4269-4277.

Holst, J. & Brock, A. (2020). Bildung für nachhaltige Entwicklung (BNE) in der Schule: Strukturelle Verankerung in Schulgesetzen, Lehrplänen und der Lehrerbildung.

https://bne.bmbfcluster.de/files/2020_BNE_Dokumentenanalyse_Schule.pdf

Keßler, S. A. (2019). Die Natur als Lernraum. Erfahrungen von Schülerinnen und Schülern auf dem SchulAcker durch die Teilnahme am Bildungsprogramm „GemüseAckerdemie“. Master thesis, Albert-Ludwigs Universität Freiburg im Breisgau.

Klug, S. (2019). Veränderung von Naturverbundenheit und Wertschätzung von Gemüse durch die GemüseAckerdemie. [Masterarbeit, Otto-von-Guericke-Universität Magdeburg]. Acker e. V.



- Kohler, F. (2018). Bildung für nachhaltige Entwicklung (BNE) im frühkindlichen Bereich. Inhaltsanalyse der Rahmenlehrpläne der Bundesländer im Elementarbereich am Praxisbeispiel des Bildungsprogramms „AckerKita“ (GemüseAckerdemie) des Ackerdemie e. V., Master thesis, Hochschule für nachhaltige Entwicklung Eberswalde.
- Koll, H. & Brämer, R. (2021). Natur auf Distanz, 8. Jugendreport Natur 2021, Universität zu Köln, Köln.
- Lohr, V. I. & Pearson-Mims, C. H. (2005). Children's active and passive interactions with plants influence their attitudes and actions toward trees and gardening as adults. *HortTechnology*, 15(3), 472-476.
- Louv, R. (2008). *Last child in the woods: Saving our children from nature-deficit disorder* (2nd ed.). Algonquin Books.
- Meier, T., Senftleben, K., Deumelandt, P., Christen, O., Riedel, K. & Langer, M. (2015). Healthcare costs associated with an adequate intake of sugars, salt and saturated fat in Germany: a health econometrical analysis. *PLoS one*, 10(9), e0135990.
- Murimi, M. W., Moyeda-Carabaza, A. F., Nguyen, B., Saha, S., Amin, R. & Njike, V. (2018). Factors that contribute to effective nutrition education interventions in children: a systematic review. *Nutrition reviews*, 76(8), 553-580.
- Nachreiner, M., Laufer, D., Belakhdar, T., Koch U., & Oeschger, A. (2020): Umweltbildung und Bildung für nachhaltige Entwicklung – zielgruppenorientiert und wirkungsorientiert! Texte 118/2020, Umweltbundesamt, 148 S.
- Nader, P. R., Stone, E. J., Lytle, L. A., Perry, C. L., Osganian, S. K., Kelder, S., ... & Luepker, R. V. (1999). Three-year maintenance of improved diet and physical activity: the CATCH cohort. *Archives of pediatrics & adolescent medicine*, 153(7), 695-704.
- Nationale Plattform Bildung für nachhaltige Entwicklung (2017). Nationaler Aktionsplan Bildung für nachhaltige Entwicklung. Zarbock: Frankfurt am Main.
- Noleppa, S., Carlsburg, M. & agripol - network for policy advice GbR. (2015). Das große Wegschmeißen: Vom Acker bis zum Verbraucher: Ausmaß und Umwelteffekte der Lebensmittelverschwendung in Deutschland. WWF Studie. <https://is.gd/ozrPc6>
- Pensini, P., Horn, E. & Caltabiano, N. J. (2016). An exploration of the relationships between adults' childhood and current nature exposure and their mental well-being. *Children, Youth and Environments*, 26(1), 125-147.
- Rademacher, C. & Heindl, I. (Hrsg.) (2019). Ernährungsbildung der Zukunft. Maßnahmen und Wirksamkeit der Professionalisierung. *Umschau Zeitschriftenverlag* ISBN 978-3930007-43-1; 176 Seiten.
- Renz-Polster, H. & Hühner, G. (2016). *Wie Kinder heute wachsen. Natur als Entwicklungsraum: ein neuer Blick auf das kindliche Lernen, Denken und Fühlen* (4. Aufl.). Weinheim: Beltz.
- Rieckmann, M. (2018). Learning to Transform the World: Key competencies in Education for Sustainable Development. In A. Leicht, J. Heiss and W. J. Byun (EDS), *Issues and Trends in Education for Sustainable Development* (pp. 39-59).
- Robert Koch-Institut (Ed.). (2018). KiGGS Welle 2 – Gesundheitsverhalten von Kindern und Jugendlichen. *Journal of Health Monitoring*, 3(2), 3-22.
- Robinson-O'Brien, R., Story, M., & Heim, S. (2009). Impact of garden-based youth nutrition intervention programs: a review. *Journal of the American dietetic association*, 109(2), 273-280.



- Rosa, C. D., Profice, C. C. & Collado, S. (2018). Nature experiences and adults' self-reported pro-environmental behaviors: The role of connectedness to nature and childhood nature experiences. *Frontiers in psychology, 9*, 1055.
- Savoie-Roskos, M. R., Wengreen, H. & Durward, C. (2017). Increasing fruit and vegetable intake among children and youth through gardening-based interventions: A systematic review. *Journal of the Academy of Nutrition and Dietetics, 117*(2), 240–250.
- Schienkiewitz, A., Brettschneider, A.K., Damerow, S. & Schaffrath Rosario, A. (2018). Übergewicht und Adipositas im Kindes- und Jugendalter in Deutschland – Querschnittergebnisse aus KiGGS Welle 2 und Trends. *Journal of Health Monitoring, 3*(1), 16–23.
- Schmidt, T., Schnieder, F., Leverenz, D. & Hafner, G. (2019). Lebensmittelabfälle in Deutschland – Baseline 2015. Johann Heinrich von Thünen-Institut, Thünen Report 71.
<https://doi.org/10.3220/REP1563519883000>
- Schenke, J. (2018). Potenziale des Bildungsprogramms GemüseAckerdemie für den Erwerb von Gestaltungskompetenz im Rahmen einer Bildung für nachhaltige Entwicklung. Master thesis, Universität Leipzig.
- Singer-Brodowski, M. (2019). III. Bildung für nachhaltige Entwicklung in der frühkindlichen Bildung. *Pfade der Transformation, 65*.
- Soga, M., Gaston, K. J., Yamaura, Y., Kurisu, K. & Hanaki, K. (2016). Both direct and vicarious experiences of nature affect children's willingness to conserve biodiversity. *International journal of environmental research and public health, 13*(6), 529.
- Stiftung Mercator Schweiz & WWF (Hrsg.) (2013). Umweltbildung – Was wirkt? Eine gemeinsame Tagung der Stiftung Mercator Schweiz und des WWF Schweiz, Zürich.
- Talukder, A., Haselow, N. J., Osei, A. K., Villate, E., Reario, D., Kroeun, H., ... & Quinn, V. (2010). Homestead food production model contributes to improved household food security and nutrition status of young children and women in poor populations. Lessons learned from scaling-up programs in Asia (Bangladesh, Cambodia, Nepal and Philippines). *Field Actions Science Reports. The journal of field actions*, (Special Issue 1).
- Überschär, L. (2022). Nagging children are saving the world. Master portfolio, HAN University of Applied Science Enschede, May 2022.
- UNESCO (2017). *Education for Sustainable Development Goals: Learning Objectives*. UNESCO: Paris.
- WBAE – Wissenschaftlicher Beirat für Agrarpolitik, Ernährung und gesundheitlichen Verbraucherschutz beim BMEL (2020). Politik für eine nachhaltigere Ernährung: Eine integrierte Ernährungspolitik entwickeln und faire Ernährungsumgebungen gestalten. Gutachten, Berlin.
- Weinert, F. E. (2001). Concept of Competences: A Conceptual Clarification. In Rychen, D. S. and Salganik, L. H. (Eds.), *Defining and selecting Key Competencies*, (pp. 45-65), Hogrefe & Huber Publishers.