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Land-Use and Health Issues in Malagasy Primary Education—A Delphi Study

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Abstract: Education for Sustainable Development (ESD) plays a key role in Sustainable Development. In low-income countries like Madagascar, this key role is particularly relevant to primary education. However, the curricula lack a comprehensive ESD approach that incorporates regional issues. In Madagascar, sustainable land-use practices (Sustainable Development Goals 12, 15) and health prevention (SDGs 2, 3, 6) are educational challenges. Procedural knowledge allows problem-solving regarding unsustainable developments. We adapted and further developed a measure of ESD-relevant procedural knowledge. Considering curricula, sustainability standards, research, and a two-round Delphi study ($n = 34$ experts), we identified regionally relevant land-use practices and health-protective behavior. After the experts rated the effectiveness and possibility of implementation of courses of actions, we calculated an index of what to teach under given Malagasy (regional) conditions. Combined with qualitative expert comments, the study offers insights into expert views on land-use and health topics: For example, when teaching ESD in Northeast Madagascar, sustainable management of cultivation and soil is suitable, particularly when linked to vanilla production. Health-protective behavior is ultimately more difficult to implement in rural than in urban areas. These results are important for further curricula development, for ESD during primary education, and because they give insights into the topics teacher education should address.

Keywords: Sustainable Development Goals; Education for Sustainable Development; primary education; Madagascar; land use; health behavior; Delphi study; procedural knowledge

1. Introduction

Madagascar aims to achieve the Sustainable Development Goals (SDGs; [1]) by 2030. For this purpose, the implementation of SDG 4: Quality Education plays a key role [2]. It contributes to all SDGs by listing "one of the most ambitious, interesting and challenging targets" [3] (p. 25): to "promote sustainable development [...] through Education for Sustainable Development and sustainable lifestyles" [1]. The implementation of SDG 4 is a challenge worldwide, especially for developing countries like Madagascar, where investments in Quality Education are low [4]. Madagascar is one of the poorest countries worldwide; approximately 77.6% of the population lives below the poverty line [4]. Madagascar faces multiple challenges related to Sustainable Development (SD). Environmental issues such as unsustainable land use (e.g., slash-and-burn practices [5] and forest degradation [6]) threaten Madagascar's unique biodiversity [7,8]. Furthermore, health issues like malaria and diseases that are partially caused by critical hygienic conditions (e.g., cholera, typhus, and diarrheal diseases) are extant threats, particularly for children [9–11].

The simultaneous promotion of biodiversity conservation, sustainable land use, and sustaining of Malagasy livelihoods [12]—addressed in the SDGs—makes Education for Sustainable Development (ESD) highly relevant. According to the SDGs, all Malagasy children should have access to primary education until 2030 [1]. Thus, formal education plays a crucial role in ESD.

The Malagasy education system faces many obstacles, including high proportions of underqualified teachers and a lack of materials and resources (cf. [13,14]). The information about the "gross intake rate to last primary grade" in Madagascar differs depending on the source: it is claimed to be around 40% [15,16] or 60–70% [14,17]. According to the latest source available, referring to data from 2016, only 68% of children enter the last grade of primary and only 37% enter the last grade of lower secondary education throughout Madagascar [17]. On average, Malagasy female pupils attend 5.8 years and male pupils 6.4 years of primary education [4]. Therefore, in Madagascar, the implementation of ESD is particularly important for primary education.

The concept of SD is perceived differently under conditions of extreme poverty [18]. Hence, ESD approaches in developing countries, such as Madagascar, must be connected to local realities (cf. [18]). While the semi-arid Southwest is extremely poor [19], the socioeconomic situation in Northeastern (NE) Madagascar, the SAVA region, has improved due to vanilla production and trade in recent years [20]. This appears to be an important factor in the health-, biodiversity- and agriculture-related education challenges connected to the SDGs (i.e., SDGs 2, 3, 6, 12, and 15). To improve local schooling and to increase the relevance of education to students, an adaption of Malagasy curricula "based on (the) region and local source of income" [13] (p. 233) has been suggested.

However, the current national school curricula in Madagascar hardly reflect regional requirements for a sensible arrangement of ESD [21]. Further hurdles to meaningful and effective instruction are the widespread shortcomings in teacher qualifications [21,22].

In the present study, we aim to identify regionally specific means for teaching ESD that allow for promotion of the SDGs, exemplified for the SAVA region. As the learning objectives in the current primary school curricula already show predominant links to SDGs 2, 3, 6, 12, and 15 [23], we focus on land-use and health issues that might be addressed in ESD. Furthermore, the approach takes into account sustainability standards that are present in Madagascar, research, and a two-round Delphi study with national and regional experts through which different perspectives with regional and educational relevance are brought together. The gained knowledge can be a starting point for future educational developments and educational programs in Madagascar.

1.1. Primary Education in Madagascar and ESD for Promoting SDGs

1.1.1. Conditions of Malagasy Primary Education

Since the colonial era, the Malagasy formal education system has mainly been based on the French system: it is divided into three years of preschooling (*maternelle*), five years of compulsory primary education (*école primaire*), four years of lower secondary education (*collège*), and three years of higher secondary education (*lycée*) [14]. Each stage has to be completed with a final exam in order to continue to the next stage [14]. Since the year 2000, the primary school enrolment rate in Madagascar has developed remarkably [14]. However, strong population growth increasingly challenges the Malagasy education system. The statistics of UNDP [4] indicate that only 15% of primary school teachers in Madagascar are trained to teach—compared to a mean of 80% in Sub-Saharan Africa; many teachers in Madagascar are underqualified [13]. Hurdles in Malagasy primary education appear particularly in rural areas (cf. [13,24]). In the SAVA region, this phenomenon leads to lower completion rates of the primary school final exam (CEPE) in rural schools (21.4%) than in urban schools (66.7%) [25].

Since 2000, Madagascar has emphasized the development of its educational sector, e.g., by designing and implementing ambitious education sector plans [14]. However, political changes led to postponement of the intended educational reforms [14,26]. The latest strategic document published by the government, the *Plan Sectoriel de l'Éducation* [27], aims to provide inclusive access to quality education for all. It includes substantial reforms, such as implementing nine years of compulsory fundamental education, more regionally adapted school curricula, and improved teacher training. Although the *Plan Sectoriel de l'Éducation* does not explicitly refer to the SDGs, its targets are in line with SDG 4: Quality Education (cf. [27]). However, the results of the latest presidential election led to indefinite suspension of the plan.

1.1.2. SDGs and Malagasy Primary Education

The Malagasy school curriculum contains general and specific learning objectives for each subject [28]. These are complemented by suggested teaching contents, activities, methods and materials, and evaluations.

A previous study by Niens et al. [23] identified starting points for further development of the current curricula with respect to ESD. As the SDGs describe the major challenges of SD with international relevance [29], the qualitative analysis focuses on the existing links between the learning objectives of the curricula and the SDGs. Most of the learning objectives address SDG 3: Good health and well-being. The second most important focus is on SDG 15: Life on land. The shares of learning objectives related to SDG 2: Zero hunger, 6: Clean water and sanitation, 11: Sustainable cities and communities, and 12: Responsible consumption and production are similar and follow SDG 15 [23]. Despite the presence of these SDG-relevant topics, the curricula do not address ESD as a comprehensive approach [21]. The references to SDGs 12 and 15 correspond to the tradition of environmental education in Madagascar that has been strongly promoted by NGOs [22]. However, their approaches are not adapted to local or regional situations [22]. Furthermore, many teachers have difficulties connecting the teaching content to regional examples (cf. [21,30]). For example, teachers in the Alaotra region in NE Madagascar perceived charcoal and fire as major environmental threats but had problems identifying a regional invasive fish species as an environmental problem [21]. Despite curricula revision for primary schools in 2015 [28], regional adaption hardly exists up to now.

The strong presence of SDGs 2, 3, and 6 in Malagasy curricula corresponds to the crucial role of primary education in the improvement of health in Madagascar [11]. This is especially true in rural areas, where medical health care is often not available [31]. To improve health and to fight malnutrition, the Malagasy state provides medical visits and promotes dental health, deworming, good hygiene and sanitation behaviors, and, sometimes, school canteens for public schools [11]. As a spillover effect, these activities positively affect school attendance by Malagasy children [14].

1.2. Topics Relevant to Promote Primary Education for SDGs in the SAVA Region

Because of their presence in the primary school curricula and their relevance for the SAVA region, land-use (e.g., SDGs 12 and 15) and health issues (e.g., SDGs 2, 3, and 6) are focused on in the following.

1.2.1. Land-Use Issues in the SAVA Region

Madagascar is one of the hottest biodiversity hotspots on Earth [7,8]. NE Madagascar is home to the highest share of remaining forest cover in the country and belongs to one of its most biodiverse regions [6,32]. However, outside of the two national parks in the SAVA region, remaining forests have declined in size in the past decades [33]. A key challenge for SD, especially in developing countries, is maintaining forests while simultaneously improving livelihood through enhanced food production [34]. Coping with this challenge requires sustainable land use [35,36]. In the SAVA region, the most common land-use options are vanilla and rice production [20]. Vanilla vines are cultivated in agroforestry systems that include tutor trees and shade trees [37]. Agroforestry has the potential to combine high agricultural yield with biodiversity conservation (cf. [38,39]), and it can thereby contribute to several SDGs (e.g., SDGs 12 and 15) [40]. Intensified monocultures such as rice paddies, on the other hand, can lead to a decreased biodiversity of cultivated land [41,42]. Biodiversity can be improved by the management of cultivation and soil (cf. [38]). Certification schemes with sustainability standards can foster the adoption of sustainable land-use strategies [34,43].

1.2.2. Health Issues in Madagascar

Diseases like malaria, cholera, and typhus are present threats in Madagascar. Also, bad hygienic conditions promote infectious diseases like diarrheal and respiratory illnesses [9–11]. Moreover, many water sources contain contaminants like pathogenic bacteria [44]. Exposure to air pollution, insufficient waste management, pesticides, and dangerous traffic constitute further health risks [11]. Likewise, undernutrition and malnutrition are widespread problems [11].

Causes of the unsatisfying health situation in Madagascar are manifold, though limited access to infrastructure and resources plays an important role across the country. Access to soap or improved sanitation [45], bed nets for protection from mosquitos [46], alternative biomass for cooking [47], and foods for balanced nutrition [48] are all limited. Access to health care and health-related resources such as point-of-care technology or trained personnel is especially weak in rural areas [31,49]. Furthermore, health is negatively affected by prevalent open defecation [45]. In the SAVA region, toilets and latrines are rare; when extant, they are generally shared and often do not conform to hygiene standards [20]. Moreover, insufficient food and body hygiene [10,45] and insufficient protection against sexually transmitted diseases are problematic [11].

1.2.3. Educational Needs Regarding Land-Use and Health Issues

To cope with land-use and health issues in Madagascar, it is important to empower the population through education (cf. [50]). In this realm, ESD benefits from the inclusion of local and regional realities (cf. [18]). Up to now, formal education on sustainable land-use practices seems to be rare (cf. [51]). As vanilla is of unique environmental, economic, and social importance for the SAVA region [20], Blanco et al. [52] suggest to address vanilla-related topics in regional education. However, which specific topics and means regarding sustainable land use in the SAVA region should be introduced into schools, remains an open question.

Coping with health issues in the SAVA region requires health-conscious behavior (cf. [53]), including health-related knowledge. In Madagascar, primary schools play an important role in health care by providing medical treatment and health training [11]. Furthermore, health-related learning objectives dominate primary school curricula [23]. As rural and urban areas have different schooling conditions [13,24,25] and different access to health-related infrastructure and sanitation [31,49,52], careful adaptation of teaching approaches to individual school settings might provide adequate education on health-conscious behaviors.

In sum, a further definition of what to teach for regionally relevant promotion of sustainable land use and health-conscious behavior in the SAVA region is needed.

1.3. Knowledge for ESD Teaching

There are several models for explaining environmental behavior and health behavior (e.g., [54–57]). In these models, knowledge plays a crucial role. The same can be said for ESD: it aims to equip learners "with the knowledge and competencies they need" [29] (p. 8) to promote SD.

The literature provides various knowledge classifications. Most of them differentiate between declarative/conceptual knowledge ("know that") and procedural/action/strategic knowledge ("know-how") (i.e., [58–61]).

Focusing on problem-solving, de Jong and Ferguson-Hessler [59] developed a knowledge model. It includes situational knowledge as knowledge about typical situations that appear in the problem-specific domain [59]. Facts, concepts, and principles appearing in this domain are part of conceptual knowledge. Procedural knowledge comprises specific actions that can change the state of the problem. Strategic knowledge depicts the problem-solving process [59]. It is often assumed that conceptual knowledge (knowledge about facts) is a prerequisite for generating procedural knowledge [58,62].

Koch et al. refer to procedural knowledge as "the cognitive skill of identifying and judging potential solutions ('strategies')" [63] (p. 1447) to SD-related problems. ESD explicitly requires action-oriented problem-solving [29]; thus, procedural knowledge is of particular importance.

Procedural knowledge, according to de Jong and Ferguson-Hessler [59], turns out to be a crucial knowledge type for ESD [63,64]. Koch et al. [63] and Richter-Beuschel et al. [64] asked Indonesian and German experts about the effectiveness of solution strategies ("courses of action", (cf. [65])) for SD aspects linked to resource use and land use. These issues often require the consideration of multiple, sometimes conflicting, perspectives, and thus often lack a definitive solution. Coping with such issues requires respective knowledge [57,63,66]. The studies of Koch et al. [63] and Richter-Beuschel et al. [64] focus on courses of action for coping with complex real-world SD issues in higher education. To the best of our knowledge, there are no studies addressing the procedural knowledge that is necessary to effectively teach in ESD in primary education.

1.4. Research Questions

Promotion of procedural knowledge regarding SD issues is a promising avenue of ESD. However, the identification of regionally relevant SD teaching issues can further benefit from expert knowledge on the effectiveness of certain courses of action.

The current curricula in Madagascar already address contents linked to SDGs 2, 3, 6, 12, and 15 [23]. These are suitable starting points for SDG-related education. Therefore, the present study focuses on defining topics connected to land-use and health issues and on charting corresponding courses of action for the promotion of procedural knowledge related to SDGs 2, 3, 6, 12 and 15 in NE Madagascar. Once regionally relevant courses of action for topics related to land-use and health issues are defined, the knowledge helps to design of culturally sensitive regional ESD curricula. For identification of ESD-relevant contents (e.g., for courses of action) Delphi studies are suitable procedures [63,64,67]. A small pre-study that included five primary school teachers in the SAVA region and utilized an instrument based on Koch et al. [63] and Richter-Beuschel et al. [64], including regionally adapted courses of action, revealed a need for further adaptation of the questionnaire. In addition to the effectiveness ratings of the courses of action, the corresponding possibility of implementation in the local setting provided significant information. These measurements led to the following main research questions (RQ1 and RQ2), and to three sub-research questions for each:

RQ1: *What land-use-related procedural knowledge is worth teaching in NE Malagasy primary schools for regionally adapted teaching of the SDGs?*

1.1 How effective and implementable are the land-use-related courses of action compiled for primary education?
1.2 How do these courses of action differ in their effectiveness and the possibility of implementation?
1.3 Which of these courses of action are worth teaching under the given conditions in NE Madagascar in order to promote biodiversity conservation and agronomic productivity?

RQ2: *What health-related procedural knowledge is worth teaching in NE Malagasy primary schools for regionally adapted teaching of the SDGs?*

2.1 How effective and implementable are the health-related courses of action compiled for primary education?
2.2 How do these courses of action differ in their effectiveness and the possibility of implementation?
2.3 Which of these courses of action are worth teaching under the given conditions in NE Madagascar in order to promote good health and well-being?

2. Method and Approach

To design an instrument for measuring procedural knowledge relevant for primary education, we focused on curricular, regional, and SDG-relevant land-use and health issues (i.e., contexts). We furthermore decided upon relevant topics that would allow operationalization in both contexts (Figure 1). For teaching the land-use issue, sustainable management of cultivation and soil are relevant topics [48,51,68]. As vanilla is the predominant cash crop in the SAVA region [20], we differentiated between vanilla and other cultivation (including rice). Regarding the health context, we chose topics related to clean water, hygiene, diet, and prevention of illnesses.

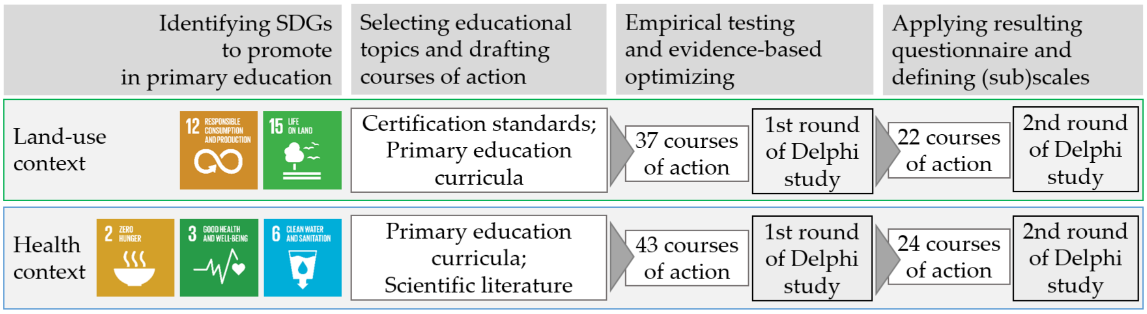

Figure 1. Developing and conducting the Delphi study on procedural knowledge for promoting Sustainable Development Goals (SDGs) in primary education.

As performed by Koch et al. [63] and Richter-Beuschel et al. [64], we operationalized procedural knowledge through judgement of courses of action. According to the selected topics, we developed courses of action relevant to ESD and promotion of the SDGs. In doing so, we drafted courses of action and then conducted a two-round Delphi study. The first round served to test the courses of action and to explore further needs to cover the relevant land-use and health issues of the SAVA region. In the second round, we used an optimized and timely feasible version of the questionnaire (Figure 1). The second round served to determine the effectiveness and possibility of implementation of the courses of action regarding land-use and health issues.

2.1. Drafting Courses of Action for Topics Relevant for Teaching Land-Use and Health Issues

We designed courses of action that were related to predominant ESD-relevant learning objectives in primary school curricula [23]. The drafted courses of action had particular relevance for the SAVA region. Thus, we focused on SDGs 12: Responsible consumption and production, and 15: Life on land in the land-use context, and on SDGs 2: Zero hunger, 3: Good health and well-being, and 6: Clean water and sanitation for the health context.

The courses of action in the land-use context derived from all 29 vanilla certification standards present in Madagascar in 2018, which were listed on the online Sustainability Standards Map by the International Trade Centre [69]. Most of these standards are also associated with rice production in Madagascar (cf. [69]). Based on these standards and on the learning objectives in Malagasy primary education curricula, we formulated sets of courses of action that incorporated the regionally and educationally relevant management of vanilla and other cultivations, as well as soil management.

For the health context, courses of action were based on health-related learning objectives present in primary education [23] and were refined using health recommendations by international development organizations and further literature [10,45–47]. In the SAVA region, nutrition and body hygiene, serious illnesses, and health risks are relevant health issues [11]. We compiled corresponding sets of courses of action.

2.2. First Round of Delphi Study and Further Development of the Questionnaire

In the first round of the Delphi study, the experts rated the (i) effectiveness and the (ii) possibility of implementation in rural life of the presented courses of action, as well as the (iii) certainty of their given answers. Completion of the paper-pencil questionnaire took place during personal interview meetings. Each meeting consisted of one expert, a local translator, the doctoral student, and/or the principal investigator. Each expert got a handout with information about the project and the data processing. The interview started only after the expert's informed consent. In the following 45 to 90 min, the expert provided personal data and filled out the questionnaire with a subsequent discussion of relevant aspects for further questionnaire development. This included suggestions for improvements of the courses of action. The experts' oral comments were noted during the survey. Each participant could choose between a French and a Malagasy version of the questionnaire. To ensure the translation quality of the French questionnaire into the local dialect, we used back-translation into French [70]. We discussed the deviations between the original French version and the back-translation and adapted the Malagasy version until we reached a satisfying translation.

According to the quantitative data and the qualitative feedback of the first Delphi round, we revised the questionnaire composition, including the courses of action. Based on the expert comments, we clarified the wording of the courses of action as well as added further ones or deleted if inappropriate. Furthermore, we adapted the questionnaire structure for the health context according to the expert feedback: in the first round, the possibility of implementation only referred to rural settings. The experts suggested to likewise include urban settings for the implementation ratings. The experts understandably did not suggest corresponding adaptions for the land-use context.

To create a timely feasible survey, we reduced the first round's 80 courses of action for both contexts to 46 courses of action in the second round. The quantitative results from the first round helped us to identify courses of action that were in principle implementable as common land-use practices or as everyday life practices. We further enriched the courses of action by regionally relevant examples in a one-week workshop with an interdisciplinary team of seven local assistants. The team consisted of seven graduates from biological, geographical, and economic disciplines and two language students. To standardize data collection, we only used the Malagasy version of the questionnaire in the second Delphi round. We put special emphasis on the translation process: the whole assistant team, including the doctoral student, made a side-by-side comparison of the French and the translated versions and adapted the Malagasy version as necessary [71].

The translation of the French items into English for the publication was done by the doctoral student, back-translated by a student assistant, and adapted as necessary [70].

2.3. Second Round of Delphi Study and Applied Instrument for Rating Courses of Action

For the second Delphi round, we first provided feedback on the results of the first round to all participants. We provided medians and percentage distributions of the ratings compiled graphically, as done by Richter-Beuschel et al. [64]. Subsequently, we gave the optimized questionnaire.

The second Delphi round was conducted with a tablet via the open-source KoBo Collect App [72], using XLS programming. All data collection took place in personal meetings (45–120 min) with a local trained assistant that were occasionally attended by the doctoral student. Oral explanations and feedback from the experts were noted by the local assistant.

Each course of action of the final instrument of the second Delphi round was rated regarding its effectiveness in one or two field/s of action: health—good health and well-being; land use—biodiversity conservation and agronomic productivity. The literal translation of "biodiversity" into Malagasy is a very technical term that is not common in local language usage. Therefore, we decided to translate "biodiversity" as "tontolo iainana", the common word for "environment", literally meaning "everything alive that surrounds me". In addition to the effectiveness ratings, each course of action was rated concerning one or two implementation setting/s: land use—rural life; health—rural and urban life. This resulted in three items per course of action with a four-point Likert scale (see Table 1).

Table 1. Concept for expert ratings of procedural knowledge on land-use and health issues relevant for primary education (L: course of action regarding land use; H: course of action regarding health).

Land-Use Context	**Field of Action**								**Implementation Settings**				**Self-Evaluation**			
Rating for the SAVA region regarding …	… conservation (and sustainable use) of the biodiversity				… agronomic productivity				… possibility of implementation in rural life				How certain are you about your ratings?			
L.1 Letting the vegetation on non-cultivated plots develop naturally (e.g., land on steep slopes, abandoned land).	Ineffective □	Little effective □	Effective □	Very effective □	Ineffective □	Little effective □	Effective □	Very effective □	Impossible to implement □	Difficult to implement □	Possible to implement □	Easy to implement □	Very uncertain □	Partly certain □	Certain □	Very certain □
…	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Health Context	**Field of Action**				**Implementation Settings**								**Self-Evaluation**			
Rating for the SAVA region regarding …	… good health and well-being				… possibility of implementation in rural life				… possibility of implementation in urban life				How certain are you about your ratings?			
H.1 Washing hands with clean water and soap (e.g., before eating, after using the latrine).	Ineffective □	Little effective □	Effective □	Very effective □	Impossible to implement □	Difficult to implement □	Possible to implement □	Easy to implement □	Impossible to implement □	Difficult to implement □	Possible to implement □	Easy to implement □	Very uncertain □	Partly certain □	Certain □	Very certain □
…	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□

The evaluation of possibility of implementation is a common prerequisite for planning pro-environmental and health-conscious courses of action (cf. [57,73]). For implementation ratings (Table 1), we asked the participants to consider practices that existed in the local population and thereby referred to extant routines, beliefs, and resources. This extended the measuring approach used in Koch et al. [63] and Richter-Beuschel et al. [64].

In general, the reliability of the results of Delphi studies benefits from the inclusion of information related to the subjective certainty of given ratings [74]. Thus, we asked the experts to evaluate their certainty for each course of action (see Table 1).

2.4. Administration of Questionnaire and Complementary Data Collection

During data collection, we first asked for personal data. Apart from age and sex, the experts provided information about their professional and voluntary activities and their experience regarding land-use and/or health issues. To assess the participants' expertise in the contexts under study, we asked them to rate their knowledge regarding selected domains of land-use and health issues (Appendix A). The experts could indicate their knowledge on a five-point Likert scale (0: *not satisfying*, 1: *satisfying*, 2: *good*, 3: *very good*, 4: *excellent*).

2.5. Sample Composition

For Delphi studies, small sample sizes of 10–18 experts are recommended [75,76]. Accordingly, the study sample consisted of 19 land-use and 20 health experts in the first Delphi round and 15 land-use and 14 health experts in the second (Appendix B). In the literature, little consensus exists regarding the definition of an "expert" within Delphi studies [74,77]. Strict definitions of an expert risk reduction of the potential sample size, especially when the study only focuses on a small region [77]. We refer to experts as representatives of a relevant working area and/or as a person in a dominant hierarchical position [77]. The working areas or institutions covered included those related to land-use and health issues and related education in the SAVA region.

To include multiple perspectives relevant for ESD or SDG promotion, we included representatives from regional ministries (n = 9), NGOs (n = 7), secondary and tertiary education (n = 7), (rural) practitioners with long-lasting expertise in health and land-use issues (n = 5), rural school directors (n = 3), and local authorities in rural areas (n = 3) in the two-round Delphi study. Because of time restrictions of the field study on-site, the selection of experts was based on convenience sampling. For the ministry group, we invited representatives from all regional ministries that had offices in the regional capital and whose working areas were related to land-use and health issues. The participants from remote rural areas were chosen from villages in three out of the four districts in the region that were already in contact with the joint project Diversity Turn in Land Use Science [20]. The experts from NGOs, secondary and tertiary education, and practitioners were mainly chosen from already-established contacts from a former project stage who corresponded to our expert definition. Further expert selection was based on recommendations by study participants. Apart from these occasional recommendations (n = 8 out of n = 25 experts in the 2nd Delphi round), the participation was completely anonymous. All participants were Malagasy, most of them living in the SAVA region. The majority of the experts participated in both Delphi rounds. The local authorities and school directors of three remote rural villages (4–8 h drive from the nearest paved roads) contributed to the first round. That helped to create a locally relevant questionnaire that includes deep rural perspectives. For the second round, those participants had to be excluded due to infrastructural restrictions. All experts got a small gift for participation.

For getting an impression of the second Delphi round: The age span of experts in the land-use context (n = 15; two females, 10 males, three not stated) was between 29 and 70 years (mean: 48.67; standard deviation: 12.91). The experts in the health context (n = 14; two females, 12 males) were 26 to 70 years of age (45.07; 14.47). In general, the experts who participated in the land-use context had a higher mean self-rated level of knowledge regarding context-specific domains (mean = 1.38 to mean = 2.31; *n* (2nd Delphi round) = 13) than did the experts who participated in the health context (mean = 1.50 to mean = 1.86; *n* (2nd Delphi round) = 12) (Appendix B).

2.6. Data Analysis

To answer the research questions, we used the data from the second Delphi round and applied IBM SPSS Statistics 25. Identifying courses of action for teaching land-use and health issues in primary education in the SAVA region followed four steps.

First, using Cronbach's alpha, we tested if the identified courses of action built reliable scales (one scale per field of action, one scale per implementation setting) for the land-use and the health contexts. We likewise tested if the courses of action built reliable subscales related to the selected topics (Tables 2 and 3). Second, we analyzed the effectiveness ratings, which give information on what can, in general, be effective with respect to the investigated fields of action (general effectiveness). Third, we shed light on regional and local situations (implementation). This allowed us to consider any severe hurdles to the implementation of courses of action in rural (and urban) settings.

Table 2. Underlying scheme for analysis in the land-use context.

	Fields of Action		Implementation Setting
Context	Scale	Scale	Scale
Topic	Subscale	Subscale	Subscale
Topic	Subscale	Subscale	Subscale
Topic	Subscale	Subscale	Subscale

Table 3. Underlying scheme for analysis in the health context.

	Field of Action	Implementation Settings	
Context	Scale	Scale	Scale
Topic	Subscale	Subscale	Subscale
Topic	Subscale	Subscale	Subscale
Topic	Subscale	Subscale	Subscale
Topic	Subscale	Subscale	Subscale

Fourth, we multiplied the rated general effectiveness by the rated possibility of implementation for each course of action to gain information on the effectiveness under the given conditions in the SAVA region (index for "what to teach under given condition")—abridged as "adjusted effectiveness." This can serve as a base for the creation of regionally sensitive teaching approaches under the given, current situation. It is a common procedure to multiply two relevant factors in order to evaluate the likelihood of performance of a specific (e.g., pro-environmental or health-conscious) course of action (cf. [56]).

For the comparison of scales and subscales, we used paired *t*-tests or repeated measures ANOVA (rmANOVA) with post hoc Bonferroni correction.

The experts' self-evaluation (certainty ratings) per course of action (Table 1) was very high for the land-use (3.87; 0.22) and the health contexts (3.89; 0.22), indicating a ceiling effect (1: *very uncertain*, 2: *partly certain*, 3: *certain*, 4: *very certain*). Thus, we did not further use this data to weigh effectiveness or implementation ratings, as it is common for Delphi studies [75].

The qualitative comments of the experts in the second Delphi round revealed that their effectiveness ratings regarding "conservation and sustainable use of biodiversity" only referred to "biodiversity conservation" (Table 1). Thus, we only refer to "biodiversity conservation" in the results. If not stated otherwise, the selected comments in the results section represent aspects that were mentioned by a minimum of five of the fifteen land-use or five of the fourteen health experts. Each comment is followed by the individual code we associated with the experts for pseudonymization.

3. Results

3.1. Land-Use-Related Procedural Knowledge for Primary Education

First, we present scales and subscales for the land-use context and give insights into descriptive statistics (sub-research question 1.1; see Section 3.1.1). Second, we report inferential data analysis regarding "general effectiveness", "possibility of implementation", and "adjusted effectiveness" on the scale and subscale levels (sub-research question 1.2; see Section 3.1.2). Third, we shed light on the "adjusted effectiveness" on course of action level for each topic. In doing so, we deepen the average quantitative ratings regarding the impact of courses of action on biodiversity conservation and agronomic productivity through use of qualitative expert comments (sub-research question 1.3; see Section 3.1.3). As a specific feature of the land-use context, we always distinguish between effectiveness for biodiversity conservation and for agronomic productivity.

3.1.1. Land-Use-Related Scales and Subscales

The data analysis revealed three scales in the land-use context (Tables 2 and 4). The Cronbach's alpha values of the scales "effectiveness for biodiversity conservation" (bc), "effectiveness for agronomic productivity" (ap), and "implementation in rural life" are between 0.77 and 0.87 (Table 4). Furthermore, we identified three topics: management of vanilla cultivations, management of cultivations other than vanilla, and soil management. Each topic included three reliable subscales (0.51–0.81), resulting in nine subscales for the land-use context (Table 4).

Table 4. Reliability of the scales and subscales of the land-use context, 2nd round of Delphi study ($n = 15$).

	Fields of Action		**Implementation Setting**
Land-Use Context in Color: Topics (*n* of Courses of Action)	**Effectiveness for Biodiversity Conservation**	**Effectiveness for Agronomic Productivity**	**Implementation in Rural Life**
Land-use scale: Management of cultivation and soil (20)	0.871	0.833	0.772
Management of vanilla cultivations (6)	0.575	0.703	0.781
Management of cultivations other than vanilla (5)	0.757	0.658	0.507
Soil management (9)	0.808	0.612	0.594

On the scale level, the management of cultivation and soil is rated more than *effective* ("general effectiveness") for biodiversity conservation (mean: 3.63; standard deviation: 0.28; range: 3.10–3.95) and agronomic productivity (3.46; 0.27; 2.95–3.80). The coding 3 signifies *effective* and 4, *very effective*. The management of cultivation and soil lies between 3: *possible* and 4: *easy to implement* (3.47; 0.23; 2.95–3.80).

The "adjusted effectiveness"—effectiveness under given conditions—of management of cultivation and soil is higher than 12 for both fields of action (bc: 12.62; 1.27; ap: 12.15; 1.38). The value 12 corresponds to, e.g., *effective* combined with *easy to implement* or to *very effective* combined with *possible to implement*. The ranges are located above 10 for both fields of action (bc: 10.75–14.65; ap: 10.20–14.25). The value 10 is derived from an answer, e.g., above *effective* and *possible to implement*.

The high ratings of "general effectiveness" (bc mean range: 3.58–3.67; ap mean range: 3.40–3.53) and "possibility of implementation" (3.34–3.64) are consistent throughout all nine subscales (Table 4; for detailed data see grey lines for subscales in Appendix C). This likewise applies to the "adjusted effectiveness" (bc mean range: 12.62–13.07; ap mean range: 11.89–12.72).

In sum, the land-use context includes courses of action that are, on the scale and subscale levels, effective for biodiversity conservation (bc) and agronomic productivity (ap) and implementable in rural life. This results in high calculated effectiveness under given conditions in the SAVA region.

3.1.2. Effectiveness for Biodiversity Conservation and Agronomic Productivity and Possibility of Implementation—Analysis on Scale and Subscale Levels

Comparing the effectiveness ratings on scale level, a paired *t*-test reveals that management of cultivation and soil is more *effective* for biodiversity conservation than for agronomic productivity (general effectiveness: t (14) = 2.93, p = 0.011; adjusted effectiveness: t (14) = 2.57, p = 0.022).

Figure 2 demonstrates that these differences likewise appear on the subscale level, are significant for soil management (p = 0.024), and show a tendency for both subscales regarding management of cultivations ($p < 0.1$). The paired *t*-tests between the "adjusted effectiveness" values for biodiversity conservation and those for agronomic productivity display a similar pattern regarding *t*- and *p*-values (same order as in Figure 2): t (14) = 1.71, p = 0.109; t (14) = 1.77, p = 0.099; t (14) = 1.98, p = 0.068.

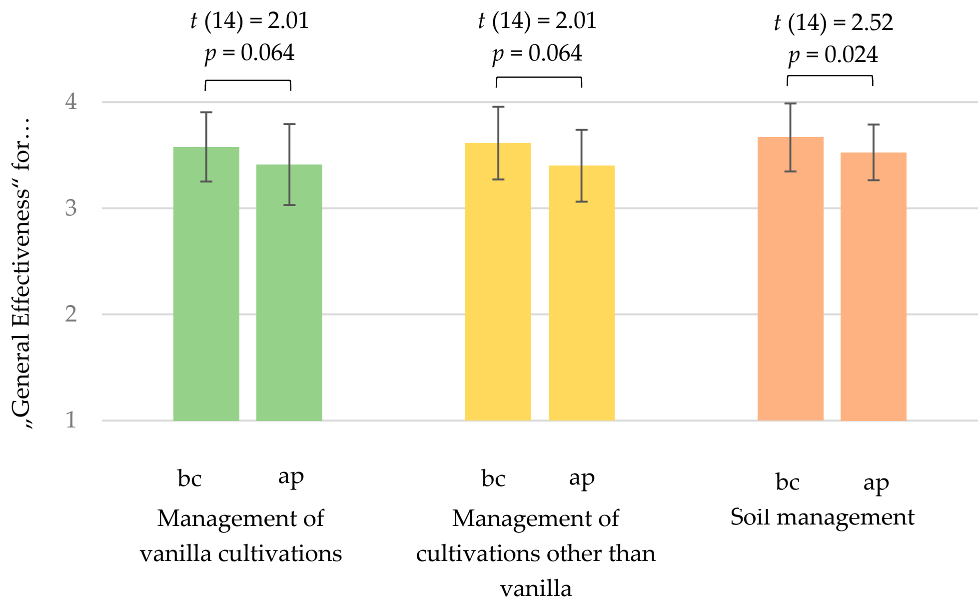

Figure 2. Mean and standard deviation of the subscales of "general effectiveness for biodiversity conservation" (bc) and "general effectiveness for agronomic productivity" (ap) regarding the three land-use topics (1: *ineffective*, 2: *little effective*, 3: *effective*, 4: *very effective*; *n*(2nd Delphi round) = 15).

Comparing the three subscales of "implementation in rural life", the rmANOVA with Greenhouse-Geisser correction reveals statistically significant differences (F(1.4, 19.6) = 4.83, p = 0.030, partial η^2 = 0.26). The post hoc Bonferroni test shows the following: The sustainable management of vanilla cultivations shows overall the highest "possibility of implementation" (data not shown). Compared to this, sustainable soil management is significantly more *difficult to implement* (p = 0.012, 0.30, 95%–CI [0.06, 0.54]).

3.1.3. Effectiveness and Possibility of Implementation of Land-Use-Related Courses of Action

Figure 3 displays the means of five variables for each course of action. The experts rated three items per course of action:

- "general effectiveness for biodiversity conservation",
- "general effectiveness for agronomic productivity", and
- "possibility of implementation in rural life."

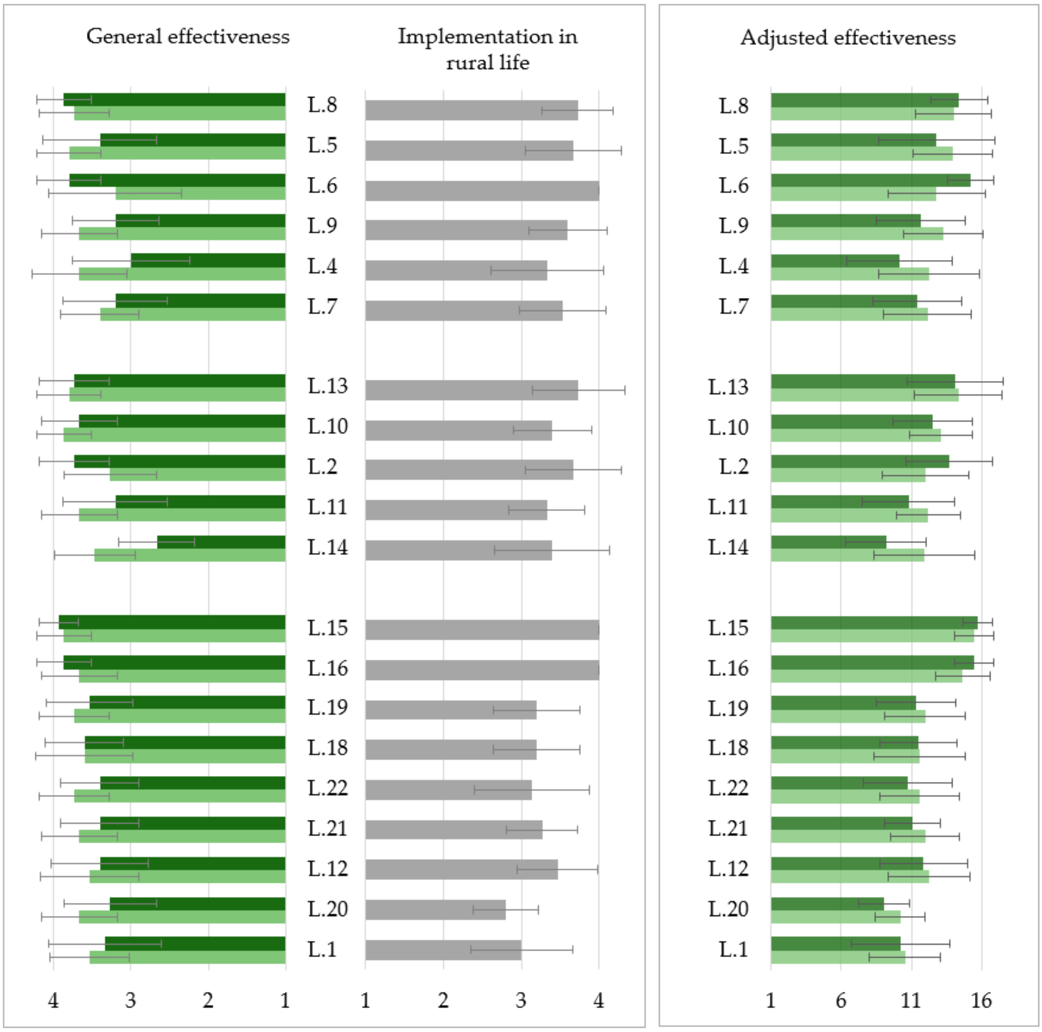

Figure 3. Mean and standard deviations of land-use items regarding "general effectiveness" (1: *ineffective*, 2: *little effective*, 3: *effective*, 4: *very effective*); "possibility of implementation in rural life" (1: *impossible to implement*, 2: *difficult to* . . . , 3: *possible to* . . . , 4: *easy to* . . .); and calculated "adjusted effectiveness" ("general effectiveness" x "possibility of implementation in rural life"); *n* (2nd Delphi round) = 15. Fields of action are differentiated by color: dark green (agronomic productivity); light green (biodiversity conservation).

The additional two variables are the calculated

- "adjusted effectiveness for biodiversity conservation" and
- "adjusted effectiveness for agronomic productivity."

In the following, we deepened the average expert ratings with qualitative expert comments. An overview of the quantitative data on the level of courses of action (descriptive and inferential) is documented in Appendices C and E. If not otherwise stated, all of the following results from the quantitative data concern the adjusted effectiveness values.

Regarding management of vanilla cultivations, all items possess a mean of minimum 3 on average (3: *effective* and 3: *possible to implement*). Thus, the "adjusted effectiveness" is remarkable: a value exceeding 9 for all courses of action.

The qualitative data particularly support the L.5 and L.6 courses of action. For example, L.5—*Having diverse endemic shade trees* (bc: 13.93; ap: 12.80; t (14) = 2.16, p = 0.048) *"[. . .] does not pose any problem if the chosen and planted species in the vanilla plantation respond to the needs of the vanilla plant"*

(V_02). L.6—*Regulating shade trees* (bc: 12.80; ap: 15.20; t (14) = −2.55, p = 0.023) is even considered to be "*[. . .] mandatory. It belongs to the requirement of the vanilla for its productivity*" (M_03).

In contrast, some courses of action show lower "adjusted effectiveness." For example, L.4—*Having a diversity of tutor trees* (bc: 12.27; ap: 10.13; t (14) = 3.81, p = 0.002) is more effective for biodiversity conservation than for agronomic productivity because it *"[. . .] could cause more expenses and more work. The best is to find one single species that is the most favorable for the soil to be cultivated*" (M_05).

According to the experts, some further courses of action require technical knowledge for adequate implementation. For example, L.7—*Burning of contaminated vanilla lianas* (bc: 12.13; ap: 11.40; $p > 0.05$) is practiced by "*most of the farmers [. . .] but to avoid the persistence of the illness, it is necessary to make a call to technicians*" (V_04). Three experts had a similar opinion regarding L.9—*Cultivation of other crops on vanilla plantations* (bc: 13.27; ap: 11.67; t (14) = 2.91, p = 0.011): e.g., "*it is very effective for the environment and also for the production. However this needs technical supervision because every plant has its own needs*" (O_06).

With respect to management of cultivations other than vanilla, all three items per course of action reach mean values higher than 3 with the exception of item L.14—*Fruit trees on hill rice cultures* regarding agronomic productivity (bc: 11.93; ap: 9.20; t (14) = 3.98, p = 0.001). On the one hand, the experts emphasized that the farmers generally do not cut fruit trees and mentioned their clear benefits as they "*constitute sources of income and also respond to their own need of fruits*" (M_04). However, fruit trees in the middle of a rice cultivation reduce the area available for rice. This reduction negatively impacts the agronomic productivity of the rice field (explanation through personal communication with the assistant team).

L.13—*Cultivation in small house gardens* shows the highest "adjusted effectiveness" values (bc: 14.33; ap: 14.13; $p > 0.05$) (Figure 3). The experts explained that such gardens can reduce pressures on biodiversity, improve household income, and help provide a healthy diet. Regarding L.10—*Planting paddy rice plants of good quality* (13.13; 12.53; t (14) = 1.87, p = 0.082) and L.11—*Sowing hill rice seeds of good quality* (12.20; 10.80; t (14) = 2.43, p = 0.029), the experts clearly differentiated between the two land-use types. Hill rice was negatively associated with the slash-and-burn technique that "*offers generally a poor production. Even if one uses a good seed, the harvest will always be limited. The most effective would be to abandon the habit of using fire*" (O_08).

Surprisingly, choosing good quality seeds for hill rice has significantly lower "adjusted effectiveness" for agronomic productivity than for biodiversity conservation (t (14) = 2.43, p = 0.029). Regarding paddy rice, however, one expert explained that the ministry "*currently [encourages] the farmers to use improved seeds to face the problems related to the current climate change*" (M_04).

Concerning soil management, the high "adjusted effectiveness" values of L.15—*Having a herbaceous undergrowth* (bc: 15.47; ap: 15.73; $p > 0.05$) and of L.16—*Using natural fertilizers in vanilla plantations* (14.67; 15.47; t (14) = −1.87, p = 0.082) are striking. These are the two vanilla-related courses of action within the topic and both are often described as obligatory for good vanilla production. Three experts stated that L.15 is practiced by most farmers, as they "*know very well the importance of herbaceous undergrowth*" (U_04).

The courses of action not related to vanilla production (L.1, 12, 18–22) have lower "possibilities of implementation" and a lower "adjusted effectiveness." Interestingly, the experts often mentioned wide-ranging challenges, such as land scarcity, as hindering factors for courses of action related to soil management. This accounts in particular for the results connected to L.1—*Natural vegetation development* (10.53; 10.20; $p > 0.05$), L.12—*Crop rotation* (12.27; 11.87; $p > 0.05$), L.19—*Fertilization of hill rice* (12.00; 11.33; t (14) = 1.85, p = 0.086) as an alternative for slash-and-burn practices, and L.20—*Recommended soil recovery* (10.20; 9.07; t (14) = 3.01, p = 0.009). The recovery of tired soil (L.20) "*is generally effective for biodiversity. However, given the current strong demographic growth, if we do not manage to propose other effective solutions to face the insufficiency of exploitable soils, this measure will not be respected*" (M_05). Furthermore, the experts mentioned the need for action by the Malagasy state, NGOs, or local communities to foster the implementation of soil-management-related courses of action. This accounts especially for L.22—*Sustainable cultivation at riversides* (11.60; 10.73; $p > 0.05$) and for L.21—*Monitoring the soil quality* (12.00; 11.07; t (14) = 1.83, $p = 0.089$). For example, for L.21, "*agronomic technicians [...] should ensure the supervision of the farmers so that they improve little by little their cultural system*" (M_04).

3.2. Health-Related Procedural Knowledge for Primary Education

With respect to the health context, we present the results in the same steps and in a similar way as for the land-use context. Thus, we answer the three sub-research questions of RQ 2 (2.1, 2.2, and 2.3) by the following three Section 3.2.1, Section 3.2.2, and Section 3.2.3. As a specific feature of the health context, we always distinguish between the possibility of implementation in rural and in urban life.

3.2.1. Health-Related Scales and Subscales

The data analysis revealed three scales in the health context (Tables 3 and 5). The Cronbach's alpha values of the scales are between 0.59 and 0.89 (Table 5). Furthermore, we identified four topics, with three reliable subscales each (0.51–0.87—except for one out of 12): consideration of clean water, sanitation and hygiene, consideration of food hygiene and healthy diet, prevention of (serious) illness and risk avoidance (Table 5). This resulted in 12 subscales for the health context.

Table 5. Reliability of scales and subscales of the health context, 2nd round of Delphi study (n = 14).

	Field of Action	**Implementation Settings**	
Health Context in Color: Topics (*n* of Courses of Action)	**Effectiveness for Good Health and Well-Being**	**Implementation in Rural Life**	**Implementation in Urban Life**
Health scale: Health prevention (21)	0.889	0.592	0.820
Consideration of clean water, sanitation and hygiene (8)	0.869	0.655	0.505
Consideration of food hygiene and healthy diet (4)	0.692	0.432	0.543
Prevention of (serious) illness (4)	0.640	0.628	0.715
Risk avoidance (5)	0.715	0.601	0.721

On the scale level, health prevention is rated more than 3: *effective* ("general effectiveness") regarding good health and well-being (mean: 3.65; standard deviation: 0.26; range: 3.05–4.00). The "possibility of implementation" of health prevention lies between 3: *possible* and 4: *easy to implement* for rural settings (rs) (mean: 3.31; standard deviation: 0.35; range: 2.25–3.62) and for urban settings (us) (3.69; 0.24; 2.95–3.95).

The averages of "adjusted effectiveness" show that the means are higher than 12 for both rural and urban settings (rs: 12.09, 1.69; us: 13.52, 1.51). The ranges are above 8 for both implementation settings (rs: 8.15–14.29; us: 10.76–15.81).

The high ratings are consistent across all 12 subscales in the health context. All subscales show mean values above 3 for "general effectiveness" (mean range: 3.47–3.71) or "possibility of implementation" (rs: 3.19–3.48; us: 3.59–3.79) (for detailed data see grey lines for subscales in Appendix D). Accordingly, the "adjusted effectiveness" also shows high values (rs: 11.80–12.59; us: 12.50–14.13).

In sum, the health-related context includes courses of action that are, on scale and subscale levels, effective for good health and well-being and are implementable in rural (rs) and urban settings (us). This results in high calculated effectiveness under given conditions in rural and urban settings in the SAVA region.

3.2.2. Effectiveness and Possibility of Implementation in Rural and Urban Life—Analysis on Scale and Subscale Levels

The paired *t*-test between the scales "implementation in rural life" and "implementation in urban life" reveals that health prevention is easier to implement in urban than in rural settings (t (13) = −7.80, $p < 0.001$; adjusted effectiveness: t (13) = −7.89, $p < 0.001$). The same pattern appears on the subscale level ($p < 0.001$) with an exception for the subscales regarding risk avoidance, which show a tendency ($p = 0.095$) (Figure 4).

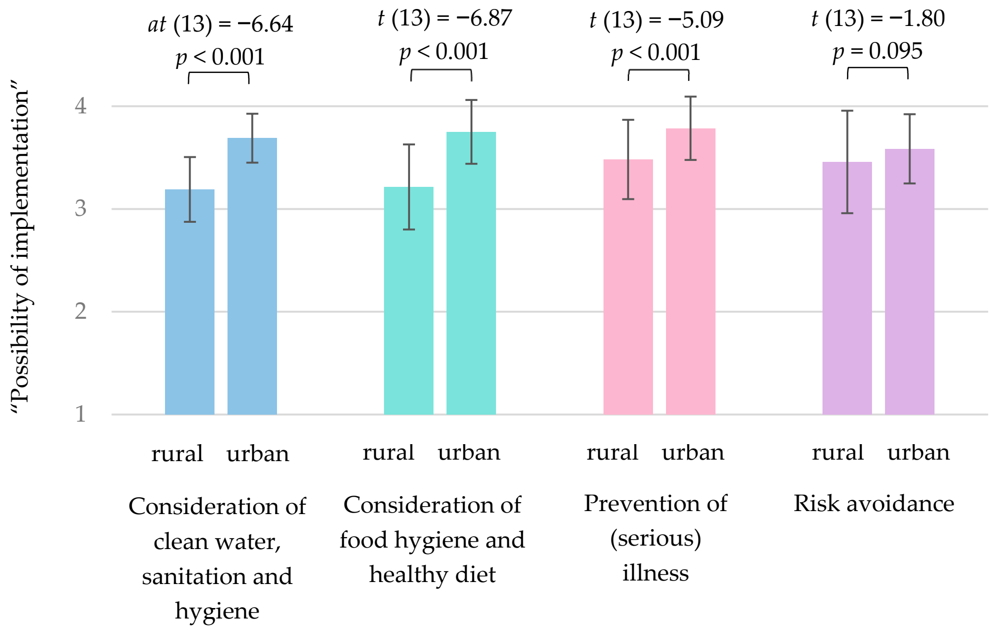

Figure 4. Mean and standard deviations of the subscales of "possibility of implementation in rural setting" and "possibility of implementation in urban setting" regarding the four health topics (1: *impossible to implement*, 2: *difficult to* . . . , 3: *possible to* . . . , 4: *easy to* . . . ; n (2nd Delphi round) = 14).

The paired *t*-tests between the "adjusted effectiveness" values for rural and urban settings show a similar pattern regarding *t*- and *p*-values (same order as in Figure 4): t (13) = −6.38, $p < 0.001$; t (13) = −7.45, $p < 0.001$; t (13) = −4.98, $p < 0.001$; t (13) = −1.66, $p = 0.121$.

Comparing the four subscales of "general effectiveness", the rmANOVA reveals significant differences between consideration of clean water, sanitation and hygiene, consideration of food hygiene and healthy diet, prevention of (serious) illness, and risk avoidance (F (3, 39) = 2.95, $p = 0.030$, partial $\eta^2 = 0.996$) (data not shown). The post hoc Bonferroni test indicates that only risk avoidance differs (it is less effective than consideration of clean water, sanitation, and hygiene) ($p = 0.044$, 0.23, 95%–CI [0.01, 0.46]).

3.2.3. Effectiveness and Possibility of Implementation of Health-Related Courses of Action

Figure 5 illustrates the means of five variables for each course of action. The experts rated three items per course of action:

- "general effectiveness for good health and well-being",
- "possibility of implementation in rural life", and
- "possibility of implementation in urban life."

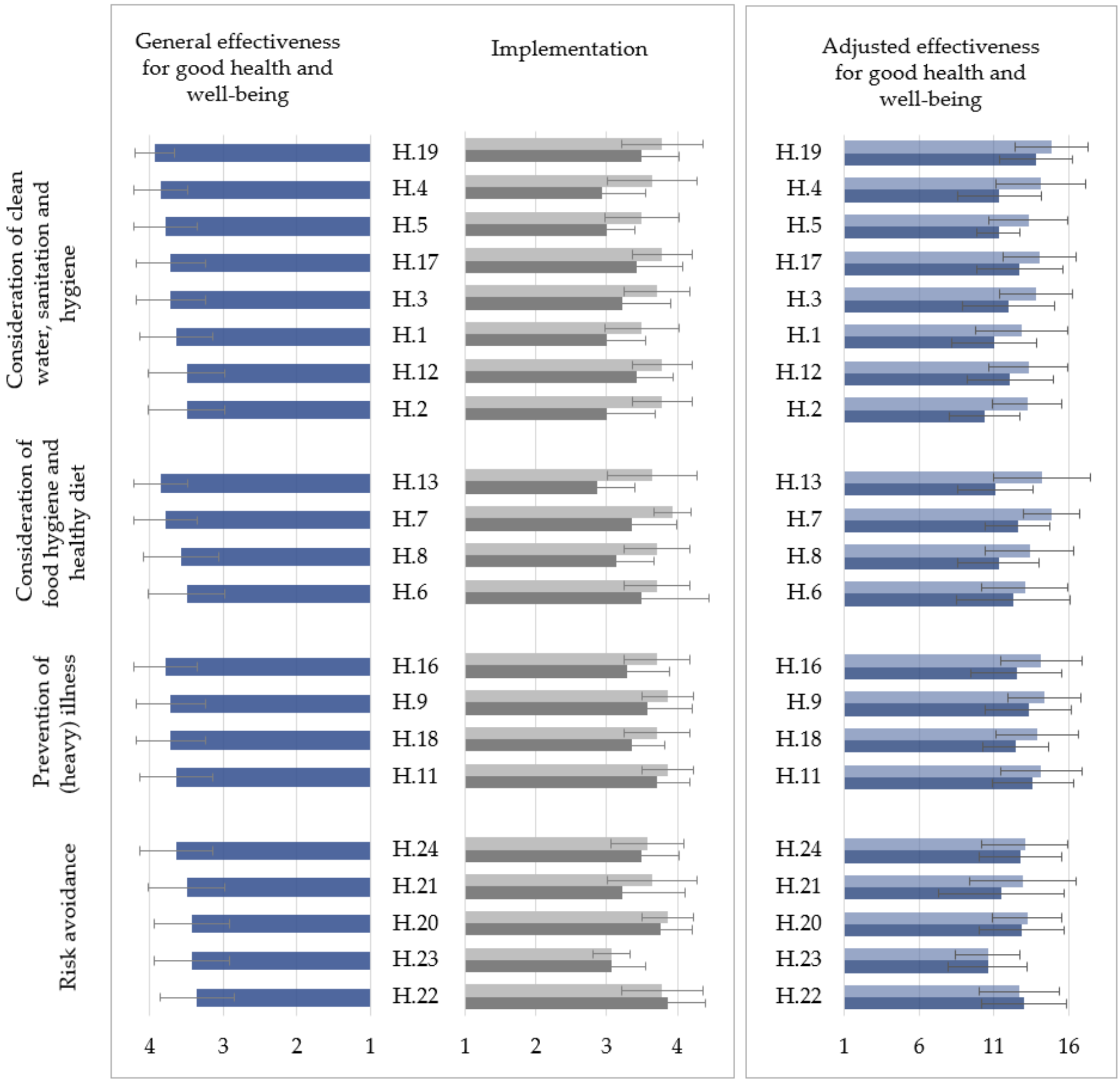

Figure 5. Mean and standard deviations of health items regarding "general effectiveness" (1: *ineffective*, 2: *little effective*, 3: *effective*, 4: *very effective*), "possibility of implementation in rural life" and " . . . in urban life" (1: *impossible to implement*, 2: *difficult to . . .* , 3: *possible to . . .* , 4: *easy to . . .*) and calculated "adjusted effectiveness" ("general effectiveness" x "possibility of implementation"); *n* (2nd Delphi round) = 14. Implementation settings are differentiated by color: dark blue/grey (rural); light blue/grey (urban).

The additional two variables are the calculated

- "adjusted effectiveness for rural life" and
- "adjusted effectiveness for urban life."

An overview of the quantitative data on the level of courses of action (descriptive and inferential) is documented in Appendices D and F.

With respect to education for SDGs 2, 3, and 6, information on the "general effectiveness" as well as on "possibility of implementation" in specific settings of health-related courses of action is important. Thus, we provide such information in this section in addition to reporting the "adjusted effectiveness" values.

The courses of action in consideration of clean water, sanitation, and hygiene refer to very basic hygienic practices. H.4—*Preparation of drinking water* (adjusted effectiveness rs: 11.36; us: 14.14; t (13) = −4.30, p = 0.001) and H.5—*Hygienic water use* (11.29; 13.29; t (13) = −2.88, p = 0.013) show lower "adjusted effectiveness" in rural than in urban settings. They are particularly effective in terms of "general effectiveness" for good health and well-being but show implementation restrictions, especially with respect to rural life. Insufficient habits and misconceptions regarding clean water are prevalent, as "*most of the people consider transparent water to be clean*" (V_01).

H.1—*Handwashing* (11.00; 12.86; t (13) = −3.55, p = 0.004) and H.2—*Teeth brushing* (10.36; 13.21; t (13) = −3.90, p = 0.002) have a slightly more restricted "adjusted effectiveness" that is again more restricted for rural than for urban life. Compared with H.1 and H.2, H.17—*Teaching these habits in school* (12.71; 14.07; t (13) = −2.67, p = 0.019) has, on a descriptive level, higher "adjusted effectiveness" values. The experts explained that teaching children is important, but the sensitization of parents plays a crucial role, too. One expert pointed out that a sensitization campaign for teeth brushing (H.2) included free toothbrushes and toothpaste. The campaign was "*not successful because the parents are not motivated*" (S_01).

H.12—*The use of hands-free constructions for handwashing, e.g., tippy-taps*, is considered to be one of the less effective ("general effectiveness") courses of action in this topic. However, the "possibility of implementation" is relatively high, resulting in considerable "adjusted effectiveness" values (12.07; 13.29; t (13) = −2.65, p = 0.020). The experts emphasized the benefits of such constructions: "*it is very effective, very easy and not expensive. However this effectiveness always depends on the frequency of sensitization*" (V_01).

Regarding consideration of food hygiene and healthy diet, H.13—*Avoidance of malnutrition* is *very effective* ("general effectiveness") but not as *easy to implement*, especially in rural settings. Thus, the "adjusted effectiveness" is lower for rural than for urban settings (11.07; 14.21; t (13) = −5.08, p < 0.001). This result was supported by expert opinion: "*in remote rural areas, vegetables are very rare, beans very expensive, the people rarely consume meat. As a result, they content themselves with eating what they find in daily life*" (S_1). Also, three experts mentioned the effects of lack of knowledge (e.g., some people "*do not know how to prepare a balanced meal*" (M_01)).

In line with these results, H.7—*The preparation of healthy meals through washing and well-cooking* has a higher "adjusted effectiveness" for urban than for rural settings (12.57; 14.86; t (13) = −3.31, p = 0.006). This course of action is closely linked to the preparation of drinking water (H.4): "*everybody has the habit to clean the food before cooking it, but the only problem is that the access to drinking water is still weak*" (O_02).

Regarding prevention of (serious) illness, H.16—Consultation of a doctor is considered to have the highest "general effectiveness." However, "*the number of caring staff is far from being proportional to the population size. The medication is very expensive. As a result, those who do not have the financial means are obliged to treat themselves at a local* 'healer'"(O_04). This challenge is particularly strong in rural areas (12.50; 14.14; t (13) = −3.10, p = 0.008).

H.11—*The use of mosquito nets* is *easy to implement*, resulting in high "adjusted effectiveness" values for rural and urban life (13.57; 14.14; p > 0.05). The experts described it as common practice, but likewise mentioned prevalent alternative conceptions: "*some only use those [mosquito nets] that are not impregnated [treated with insecticide], because they fear respiratory diseases*"(U_02).

Concerning risk avoidance, most courses of action have approximately equal "adjusted effectiveness" in urban and rural life. An exception is H.21—*The safe use of pesticides*, which has higher values for urban settings (11.50; 12.93; t (13) = −2.22, p = 0.045) (see Appendix D). The experts mentioned the need for specific instruction to reduce the health risk regarding H.21: "*the sellers of pesticides should explain to their clients how to handle the products*" (O_03).

Likewise, the experts mentioned the need to better inform the population about H.23—*Respecting the security rules for driving* (10.57; 10.57; p > 0.05) as "*many drivers of motorbikes or cars do not master the traffic rules and drive with excessive speed*"(O_02). In both rural and urban settings, H.23 displays the lowest "implementation" ratings and the lowest "adjusted effectiveness" values of all risk avoidance courses of action. To foster the implementation of H.23, the experts called for increased controls: "*the responsible authorities should be strict and fair with the execution of penalties regarding the non-compliance of security and traffic rules*" (S_01).

4. Discussion

In this study, we identified regionally relevant topics and corresponding courses of action that can be incorporated into NE Malagasy primary education in order to promote SD-relevant procedural knowledge. The topics cover land-use issues (referring to SDGs 12 and 15) and health issues (referring to SDGs 2, 3, and 6). Expert ratings (second round of Delphi study) gave us information on

- the "general effectiveness" of courses of action with respect to land use and health—regardless of the possibility of implementation;
- the "possibility of implementation" of the courses of action in rural (and additionally, for the health context, urban) life in the SAVA region; and
- the calculated effectiveness under given conditions in the SAVA region, which can function as an index for "what to teach regarding ESD" under the given specific socioeconomic conditions (abridged as "adjusted effectiveness" value).

The "possibility of implementation" and hence the "adjusted effectiveness" of the courses of action can change over time depending on, among other factors, prosperity and support for primary education. The index, therefore, represents a "snapshot" of the conditions during the time of the study in 2018. Thus, the presented approach has two foci: (i) "general effectiveness", indicating the general, perhaps long-term (depending on improved socioeconomic conditions) relevance for regionally relevant ESD, and (ii) "adjusted effectiveness", indicating what to teach regarding ESD under the given specific socioeconomic conditions in 2018. From these results we can derive what to prioritize for regionally adapted ESD in primary education in the SAVA region, both now and in the future.

We discuss the issues of land use and health consecutively. For both, the focus first lies on the scale and subscale levels. Subsequently, we discuss the results on the level of courses of action.

4.1. Land-Use Topics for Teaching Procedural Knowledge to Promote SDGs 12 and 15 in the SAVA Region

The identified topics management of vanilla cultivations, management of cultivations other than vanilla, and soil management built reliable subscales of the three primary scales within the land-use context (biodiversity conservation, agronomic productivity, and possibility of implementation in rural life) (Table 4).

Higher ratings of "general effectiveness" for biodiversity conservation than for agronomic productivity on scale and subscale levels show that the experts clearly differentiated their ratings between the two fields of action. This is plausible in light of the sustainability standards considered for the development of the courses of action (Figure 1). The majority of these standards have an explicit focus on environmental aspects, including on the maintenance of soil, forests, and biodiversity, whereas management aspects, such as production efficiency, are only marginally included (cf. [69]).

The management of vanilla cultivations and the vanilla-related courses of action within soil management (L.15 and L.16) have a particularly high "possibility of implementation" (Figure 3). This indicates that agroforestry—combining high yields with biodiversity conservation [39,40]—is worth teaching in the SAVA region.

Moving on to the results on the courses of action level, the experts explained that courses of action such as having a diversity of endemic shade trees (L.5) or shade regulation (L.6) are common practice in vanilla cultivation in the SAVA region. For evaluation of the potential of shade tree diversity (L.5) for biodiversity conservation, the following has to be considered: most vanilla cultivations are either derived from former fallows or from forests. Fallow-derived cultivations have a low tree diversity, but their establishment increases biodiversity. Forest-derived cultivations have a high tree diversity, but their establishment decreases biodiversity [78]. This, again, is an issue to be considered in regionally adapted teaching.

Furthermore, the diversification of tutor trees (L.4) used in the cultivation of vanilla shows a high "adjusted effectiveness" for biodiversity conservation, but lower "adjusted effectiveness" for agronomic productivity. The experts emphasized the increased workload of this practice. Planting a diversity of tutor trees in agroforestry systems is part of the sustainability standards of vanilla certifiers [69]. These standards "typically consist of a core generic standard that may have difficulties doing justice to the highly variable conditions under which crops are produced across the tropics" [43] (p. 19).

The enhanced agronomic productivity of intensive use of land presented in management of cultivations other than vanilla (e.g., paddy rice monocultures) is generally accompanied by decreased biodiversity [41,42]. However, two courses of action have no significant differences in the "adjusted effectiveness" regarding biodiversity conservation and agronomic productivity: fertilization of paddy rice cultures (L.10) and cultivation of small gardens (L.13).

The experts clearly differentiated between paddy rice (L.10) and hill rice (L.11). Hill rice was negatively associated with slash-and-burn practices that contribute to biodiversity loss and decreased soil fertility in Madagascar [5,51]. Previous interventions to encourage farmers in NE Madagascar to replace self-provisioning hill rice production with cash crops like vanilla or coffee have not been successful (cf. [5]). This is most likely connected to the long tradition of slash-and-burn practices and self-provisioning [5]. The expert associations indicated that these complex factors should be taken into account when addressing unsustainable hill rice production in primary education.

Interestingly, the high "adjusted effectiveness" of cultivation in small house gardens (L.13) for biodiversity conservation and agronomic productivity was particularly supported by the qualitative comments. Currently, teaching gardening practices through school gardens is not common in primary schools in the SAVA region [25].

Soil management appears to be more difficult to sustainably implement than is the management of vanilla cultivations. The majority of experts mentioned land scarcity as a hindering factor in implementation of sustainable soil management, such as letting tired soil recover (L.20). This led to lower "adjusted effectiveness" values. Indeed, strong demographic growth is a major factor in the expansion of cropland in NE Madagascar [5]. Less available land forces poor rural households to practice unsustainable soil management (e.g., shorter fallow cycles) and prioritize short-term benefits over long-term biodiversity conservation [12,68]. This land scarcity, as mentioned in the expert comments, makes obvious that courses of action that are closely connected to sufficient land access would not fit the local realities in NE Madagascar.

The experts mentioned the need for technical supervision regarding three courses of action in the land-use context (L.7, L.9, and L.21). This response indicates that implementation requires specific knowledge far beyond primary education. Nevertheless, introducing such practices already at the primary level could be beneficial for sustainable land use (cf. [68]).

4.2. Health Topics for Teaching Procedural Knowledge to Promote SDGs 2, 3, and 6 in the SAVA Region

The identified topics consideration of clean water, sanitation, and hygiene, consideration of food hygiene and healthy diet, prevention of (serious) illness, and risk avoidance built reliable subscales of the three primary scales within the health context (good health and well-being, possibility of implementation in rural life and possibility of implementation in urban life) (Table 5).

On scale level, the experts gave, on average, remarkably high effectiveness ratings ("general effectiveness"). This is particularly the case for consideration of clean water, sanitation, and hygiene, for consideration of food hygiene and healthy diet, and for prevention of (serious) illness. In terms of health prevention, the courses of action are easier to implement in urban than in rural settings.

In Madagascar, the consideration of clean water, sanitation and hygiene is promoted by "Water, Sanitation and Hygiene" (WASH) initiatives that are, inter alia, active in primary schools (cf. [45]). Yet, differences between rural and urban WASH habits are still prevalent [49,52]. Most of the primary schools in the SAVA region lack direct access to water [25], which is an important hindering factor for practicing handwashing (H.1) and teeth-brushing (H.2) in school. Thus, both courses of action plausibly show a restricted "adjusted effectiveness", especially in rural areas. Here, the use of tippy-taps (H.12) with higher "implementation" ratings in rural settings can be an option for enhancing water access for handwashing, etc., in primary schools (cf. [79]). As the experts mentioned, households habits can be a hindering factor for regular hygiene practices, so teaching these practices in school (H.17) is highly relevant (cf. [80]).

Surprisingly, the experts rated the use of latrines (H.19) as *easy to implement* in rural and urban areas, resulting in a remarkable high "adjusted effectiveness" for both implementation settings (Figure 5). However, the low number of latrines and toilets in Malagasy households restricts the use of latrines, particularly in rural areas [20,49].

Concerning food hygiene and healthy diet, limited market access in rural areas makes a healthy diet highly dependent on the seasonal availability of fruits and vegetables (cf. [48]). In rural settings, many households suffer from dietary deficiencies during the annual hunger gap [48]. In contrast, food hygiene practices (i.e., cleaning the food and well-cooking—H.7) seem to be common in Madagascar even if urban households are more aware of the importance of clean food, compared to rural households [81]. These results suggest that differences in urban and rural settings should be taken into account when connecting teaching to local realities.

Regarding prevention of (serious) illness, existing infrastructure includes severe barriers, particularly in rural areas [31,49]. As a result, rural households, in comparison to urban households, seek professional health care less often (H.16) and more often choose self-medication or consultation with traditional healers [31,49]. In contrast, the use of bed nets to fight malaria (H.11) is common in urban and rural areas. Mass distribution campaigns of impregnated mosquito nets may be partially responsible for decreasing child mortality in Madagascar [46].

The experts rated courses of action related to risk avoidance as, tendentially, easier to implement in urban than in rural areas (Figure 5). Respecting the security rules when driving (H.23) shows the lowest "possibility of implementation" in both urban and rural areas. Traffic accidents are a severe problem in Madagascar [11]. As the *Plan Sectoriel de l'Éducation* was indefinitely suspended in 2019, introduction of road safety education into primary education as part of *Éducation civique* (cf. [23,82]) remains unclear. Similarly, the current primary school curricula do not include the importance of body protection during pesticide use (H.21) (cf. [28]). However, most of the untrained vendors of low-cost phytosanitary products are unable to appropriately inform their clients about environmental and health risks of pesticide use [83]. This causes "a serious threat to agro-ecological balance and health" [83] (p. 35).

4.3. Limitations

It was difficult to include an equal number of men and women in the study; women are underrepresented among the group that corresponds to our expert definition (see Section 2.5). Where possible, we explicitly invited women, but many refused participation due to lack of time. Instead, they mostly proposed male representatives. Therefore, a potential gender bias of the ratings has to be considered. As traditional gender roles and labor division are still prevalent in Madagascar [84,85], even among the more highly educated population [86], a biased perspective is possible (e.g., on daily household activities). This bias could potentially cause less reliable implementation ratings regarding courses of action related to household activities, such as food preparation.

Furthermore, the data show that experts in the health context had a lower self-estimation of knowledge than the experts in the land-use context (Appendix A).

As experts from remote rural areas had to be excluded in the second round due to infrastructural restrictions, the sample composition of the second round predominantly consists of experts from urban areas. Only three practitioners that participated in the second Delphi round come from rural areas. Thus, the expert ratings regarding "possibility of implementation in rural areas" could be biased. Nevertheless, both the first and second Delphi round included a rich sample composition that resulted in valuable information from multiple local perspectives (Appendix B).

Moreover, the answering format shows a limitation. Compared to the relative specificity of the effectiveness ratings, the implementation ratings are vaguer, as they refer to existing routines, beliefs, and resources. However, we were able to gain clarity through complementing the quantitative data with the qualitative expert comments.

5. Conclusions and Future Work

In this section, we give recommendations for land-use and health issues, draw conclusions, and provide an outlook on future work. In this study, we successfully elaborated a Delphi approach for the regionally sensitive identification of courses of action that are relevant for ESD in a development context, exemplified for the SAVA region. We identified topics to teach regarding land-use and health issues in the SAVA region. The corresponding courses of action are regionally effective and implementable and are generally worth teaching in regionally adapted primary education in ESD for SDGs.

In light of the gained knowledge of our study, regional ESD benefits from the following:

The higher general effectiveness of land-use topics regarding biodiversity conservation compared to agronomic productivity led to the necessity of additionally addressing further teaching content that focuses on agronomic productivity in ESD. Blanco et al. [52] suggested introducing into regional education vanilla-related teaching approaches unique to the SAVA region. Indeed, vanilla-related courses of action turned out to be particularly suitable for ESD in the SAVA region. However, the teaching has to be linked to the given situations (e.g., fallow- and forest-derived vanilla cultivation) in order to adequately address, for example, the value of shade tree diversity. With respect to management of cultivations other than vanilla, teaching gardening practices through school gardens (L.13) should be particularly promoted—especially as these practices also promote healthy diet in the health context. Even if some courses of action related to land use require specific knowledge for correct implementation (i.e., L.7, L.9 and L.21), it is worth addressing them at the primary level in order to highlight their relevance and meaningfulness for further learning in ESD (cf. [68]).

Based on the qualitative expert comments, courses of action regarding hill rice (L.10) and land scarcity (L.1, L.12, L.19, and L.20) ultimately did not completely fit the local realities. Regionally relevant teaching of such courses of action requires consideration of multiple factors that are linked to unsustainable hill rice production and land scarcity.

The striking differences between the "possibility of implementation" of health-related courses of action in rural and in urban settings highlight that health education requires an adaption to the rural or urban school setting. This applies particularly to the topics of clean water, sanitation and hygiene, food hygiene and healthy diet, and prevention of (serious) illness. The required adaption implies the consideration of, for example, existing water sources for teaching drinking water treatment, distance to health facilities for teaching medical treatment, and regional and seasonal availability of foods for teaching healthy diet. Furthermore, primary schools should explicitly target parents and "encourage more student-to-home messages" [45] (p. 26) in order to foster sustained health-conscious behavior.

Regarding risk avoidance, the safe use of pesticides (H.21) turned out to be particularly relevant for primary education, especially for rural areas. Road safety education (H.23) appears to be equally relevant for rural and urban settings. As both courses of action are currently not part of the primary school curricula, their integration should be considered for further developments.

In sum, the findings of this study highlight the importance of quantitative and qualitative information about current conditions on-site when one is designing regionally relevant school curricula with concrete links to local realities. The newly established index "adjusted effectiveness" explicitly considers the given socioeconomic conditions. The index is especially integral for understanding background information in low-income countries, for defining hurdles that must be overcome, and for figuring out what works. Such information makes the gained knowledge particularly relevant for regionally sensitive approaches (in our case, for the SAVA region).

As a result, the present study provides starting points for further developing primary school curricula in the SAVA region with respect to ESD, as intended in the *Plan Sectoriel de l'Éducation* [27]. Moreover, the gained knowledge can serve as a reference for NGOs that currently strongly contribute to environmental education in Madagascar [22] and to promotion of health in schools (e.g., [45]).

The successful implementation of a certain curriculum always depends on corresponding teacher knowledge. To design appropriate SD teacher trainings for land-use and health-related SDGs, it is necessary to gain information on teacher prerequisites for teaching procedural knowledge linked to specific SDGs. Therefore, the teacher's procedural knowledge has to be assessed, which we intend to do in future research. For this purpose, the results of the present Delphi study on expert effectiveness and implementation ratings, as displayed in Appendix C (land use) and Appendix D (health), can serve as a benchmark. This benchmark is suitable to use in the assessment of teacher procedural knowledge, as it is a highly important knowledge type for SD-related problem-solving. Following the procedure successfully applied by Richter-Beuschel and Bögeholz [87], our research provides a tool for making primary teacher procedural knowledge measurable in two crucial contexts of ESD. In doing so, the study provides a suitable standard with regional relevance (land use) and relevance for low-income countries (health context). Knowledge of corresponding teacher procedural knowledge and thus their prerequisites for further teacher education is integral to achieving the SDGs. In Madagascar, this applies particularly to primary education, as it is the highest level of formal education for most of the population. Our benchmark for measuring procedural knowledge on land-use and health issues allows for progress in evidence-based primary teacher ESD and for further education on the SDGs in the future.

In addition to allowing the assessment of primary teacher procedural knowledge on land-use and health issues in the future, the study argues mainly for the following benefits: (i) identifying suitable means to promote SDG-relevant procedural knowledge in primary education, and (ii) providing a procedure to define "what works", both in general and under given specific socioeconomic conditions. This study might thereby inspire future research into regionally adapted educational measures for promotion of the SDGs. Regarding the identified land-use and health issues, this study primarily accounts for Madagascar, specifically the Northeastern region of the country. However, with only a few adaptions, especially regarding the health issue, this procedure is applicable in other low-income countries far beyond the SAVA region of Madagascar.

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Appendix A. Expert Self-Rated Knowledge

Table A1. Self-rated knowledge by experts that participated in the second Delphi round in the land-use context (*n* (2nd Delphi round) = 13) and the health context (*n* (2nd Delphi round) = 12) (mean: M; standard deviation: SD; 0: *not satisfying*, 1: *satisfying*, 2: *good*, 3: *very good*, 4: *excellent*).

Land-Use Context			**Health Context**		
Domain of Self-Estimation	**M**	**SD**	**Domain of Self-Estimation**	**M**	**SD**
Sustainable development	2.31	1.18	Well-being	1.86	1.17
Education for Sustainable Development	2.23	1.17	Sustainable Development	1.71	0.99
Agricultural education	2.23	1.36	Health	1.57	1.28
Education for biodiversity conservation	2.08	1.19	Health education	1.57	1.22
Vanilla production	2.08	1.04	Clean Water	1.57	1.02
Paddy rice production	1.92	0.95	Sanitation	1.50	0.94
Biodiversity conservation	1.85	1.21	Education for Sustainable Development	1.50	0.94
Hill rice production	1.69	1.03			
Agronomic productivity of ecosystems	1.38	1.04			

Appendix B. Sample Composition

Table A2. Sample composition of the two rounds of the Delphi study (*n* (Both Delphi rounds) = 34) in land-use and health context.

<table>
<tr><th>Representatives from Working Areas/Institutions</th><th>Land-Use Context
n (Both Delphi Rounds) = 23;
n (1st Delphi Round) = 19;
n (2nd Delphi Round) = 15</th><th>Health Context
n (Both Delphi Rounds) = 22;
n (1st Delphi Round) = 20;
n (2nd Delphi Round) = 14</th></tr>
<tr><td rowspan="2">Local directorates of national ministries</td><td>Regional Directorate of Agriculture and Animal Husbandry (58), Regional Directorate of Environment, Forests and Tourism (29), Regional Directorate of Rural Development (48) [2]</td><td>Regional Directorate of the Population (35), Regional Directorate of National Education (Responsible for school health) (42), Regional Directorate of Water, Energy and Hydrocarbon (60) [1]</td></tr>
<tr><td colspan="2">Regional Directorate of National Education (42) [1], Regional Directorate of National Education (44) [2], Regional Directorate of Water, Energy and Hydrocarbon (53) [2]</td></tr>
<tr><td>NGO/Association</td><td>CARE International (57), Duke Lemur Center (42), Graine de Vie (38)</td><td>Save the Children (31), Program MAHEFA Andapa (31), Program MAHEFA Sambava (50), VATIFA (35)</td></tr>
<tr><td rowspan="2">Secondary and tertiary education</td><td>Ph.D. Student in Ecology (33), Teacher of Technical School of Agriculture (45), Professor at Department of Sustainable Agriculture, University of Antananarivo (40) [1]</td><td>Professor at Medical Faculty, University of Diego (60), Teacher of Paramedical Institute (29), Teacher of Paramedical Institute (26)</td></tr>
<tr><td colspan="2">Teacher in leading position of CURSA University Andapa (58)</td></tr>
<tr><td rowspan="2">Practitioners</td><td>Vanilla expert (n.a.) [2], Vanilla expert (68), Leader of local vanilla farmers' association (47)</td><td>Doctor in rural health center (62)</td></tr>
<tr><td colspan="2">Vanilla expert and influential person on community level (70)</td></tr>
<tr><td>Rural school directors</td><td colspan="2">Director in district of Andapa (43) [1], Director in district of Antalaha (43) [1], Director in northern district of Sambava (29)[1]</td></tr>
<tr><td>Local authorities in rural areas</td><td colspan="2">Deputy of village chief in district of Andapa (47) [1], Sector chief in district of Antalaha (40) [1], Village chief in northern district of Sambava (47) [1]</td></tr>
</table>

Age indication at the time of study participation (May 2018—January 2019), [1] = only first round; [2] = only second round; n.a. = age not stated.

Appendix C. Expert Ratings Regarding Land-Use Issues—Benchmark

Table A3. Rated courses of action in the land-use context. Second Delphi round; each topic includes three subscales (i.e., one subscale per field of action/implementation setting); *n* (2nd Delphi round) = 15; mean: M; standard deviation: SD.

Topic	Course of Action	Fields of Action				Implementation Setting	
		Biodiversity Conservation		Agronomic Productivity		Rural Life	
		M	SD	M	SD	M	SD
Management of vanilla cultivations	L.4 Having a diversity of tutor trees (e.g., jatropha, gliricidia, coffee) on the vanilla plantations.	3.67	0.62	3.00	0.76	3.33	0.73
	L.5 Having a diversity of shade trees of Malagasy origin on the vanilla plantations (e.g., albizia, tsararavigny).	3.80	0.41	3.40	0.74	3.67	0.62
	L.6 Regulating the shade on the vanilla plantations (e.g., by trimming the trees and bushes).	3.20	0.86	3.80	0.41	4.00	0.00
	L.7 Uprooting the vanilla lianas that are contaminated in the plantations, burning them, and burying them.	3.40	0.51	3.20	0.68	3.53	0.52
	L.8 Selecting vanilla lianas of good quality for planting (e.g., healthy lianas that are resistant to disease and tolerant towards environmental influences).	3.73	0.46	3.87	0.35	3.73	0.46
	L.9 Having cultivated plants other than vanilla on the vanilla plantations (e.g., coffee, cacao).	3.67	0.49	3.20	0.56	3.60	0.51
	Subscales of management of vanilla cultivations	3.58	0.33	3.41	0.38	3.64	0.36
Management of cultivations other than vanilla	L.2 Not letting invasive plants grow in an uncontrolled manner (e.g., water hyacinth, *Lantana camara*).	3.27	0.60	3.73	0.46	3.67	0.46
	L.10 Planting paddy rice plants of the previous harvest that are of good quality (e.g., healthy plants that are resistant to diseases and tolerant towards environmental influences).	3.87	0.35	3.67	0.49	3.40	0.51
	L.11 Sowing seed of hill rice of the previous harvest that has a good quality (e.g., healthy seeds that are resistant to diseases and tolerant towards environmental influences).	3.67	0.49	3.20	0.68	3.33	0.49
	L.13 Cultivating fruits and vegetables in small gardens next to the house (e.g., oranges, litchis, tomatoes, eggplants).	3.80	0.41	3.73	0.46	3.73	0.59
	L.14 Leaving fruit trees on the hill rice cultures (e.g., mango, litchi).	3.47	0.52	2.67	0.49	3.40	0.74
	Subscales of management of cultivations other than vanilla	3.61	0.34	3.40	0.34	3.51	0.35
Soil management	L.1 Letting the vegetation on non-cultivated plots develop naturally (e.g., land on steep slopes, abandoned land).	3.53	0.52	3.33	0.73	3.00	0.66
	L.12 Alternating the hill rice with different cultures during the year (e.g., tomatoes, beans, cucumber).	3.53	0.64	3.40	0.63	3.47	0.52
	L.15 Having an herbaceous undergrowth on the vanilla plantations to fix the soil during the year (e.g., lawn, grass).	3.87	0.35	3.93	0.26	4.00	0.00
	L.16 Fertilizing the vanilla plantations with natural fertilizer (e.g., branches and leaves left from the cleaning).	3.67	0.49	3.87	0.35	4.00	0.00
	L.18 Fertilizing paddy rice cultures (e.g., with manure, compost).	3.60	0.63	3.60	0.51	3.20	0.56
	L.19 Fertilizing hill rice cultures (e.g., with residues from the previous harvest).	3.73	0.46	3.53	0.52	3.20	0.56
	L.20 Letting tired soil recover during a recommended period (e.g., the soil where slash-and-burn has been practiced).	3.67	0.48	3.27	0.59	2.80	0.41
	L.21 Monitoring the soil quality on hill rice cultures and adapting the cultures to the soil conditions (e.g., alternating the cultures during the year, doing companion planting).	3.67	0.49	3.40	0.51	3.27	0.46
	L.22 Having plants with big roots at riversides and river mouths to retain the soil (e.g., keeping trees and bushes, not cultivating sweet potatoes).	3.73	0.46	3.40	0.51	3.13	0.74
	Subscales of soil management	3.67	0.32	3.53	0.26	3.34	0.24

Appendix D. Expert Ratings Regarding Health Issues—Benchmark

Table A4. Rated courses of action in the health context. Second Delphi round; each topic includes three subscales (i.e., one subscale per field of action/implementation setting); *n* (2nd Delphi round) = 14; mean: M; standard deviation: SD.

Topic	Course of Action	Field of Action		Implementation Settings			
		Good Health and Well-Being		Rural Life		Urban Life	
		M	SD	M	SD	M	SD
Consideration of clean water, sanitation, and hygiene	H.1 Washing hands with clean water and soap (e.g., before eating, after using the latrine).	3.64	0.50	3.00	0.56	3.50	0.52
	H.2 Brushing the teeth regularly and in a recommended way (e.g., two times a day, with a toothbrush and toothpaste).	3.50	0.52	3.00	0.68	3.79	0.43
	H.3 Respect the hygiene rules for the genital organs (e.g., washing them regularly, wearing clean underwear, using clean sanitary towels during the menstruation).	3.71	0.47	3.21	0.70	3.71	0.47
	H.4 Prepare drinking water (e.g., treating with unexpired solutions like Sur'Eau, using filters, boiling water).	3.86	0.36	2.93	0.62	3.64	0.63
	H.5 Respect the hygiene rules concerning water use (e.g., retrieving treated water with a clean utensil, storing treated water in reservoirs with a solid cover).	3.79	0.43	3.00	0.39	3.50	0.52
	H.12 Having constructions for hands-free hand washing (e.g., a tap, a tippy-tap).	3.50	0.52	3.43	0.51	3.79	0.42
	H.17 Learning good techniques of daily hygiene in school (e.g., hand washing, tooth brushing).	3.71	0.47	3.43	0.65	3.79	0.43
	H.19 Using the latrine instead of open defecation and keeping it clean (e.g., rinsing with water, refilling and regularly changing the provided water, covering the hole).	3.93	0.27	3.50	0.52	3.79	0.58
	Subscales of consideration of clean water, sanitation and hygiene	3.71	0.32	3.19	0.32	3.69	0.24
Consideration of food hygiene and healthy diet	H.6 Storing food in safe places (e.g., protected from insects, rats, dust, heat, humidity).	3.50	0.52	3.50	0.94	3.71	0.47
	H.7 Preparing healthy meals (e.g., cleaning the food with clean water, cooking the food thoroughly).	3.79	0.43	3.36	0.63	3.93	0.27
	H.8 Preserving food that is still fresh (e.g., drying fish, salting meat, preparing jam from fruits).	3.57	0.51	3.14	0.54	3.71	0.47
	H.13 Avoiding malnutrition (e.g., eating regularly, eating balanced meals, eating fruits and vegetables with vitamins and minerals).	3.86	0.36	2.86	0.54	3.64	0.63
	Subscales of consideration of food hygiene and healthy diet	3.68	0.24	3.21	0.41	3.75	0.31
Prevention of (serious) illness	H.9 Avoiding to have nesting sites for mosquitos around the house (e.g., drying out puddles, draining standing water, covering standing water with soil).	3.71	0.47	3.57	0.65	3.86	0.36
	H.11 Sleeping under an impregnated mosquito net without holes (e.g., a new mosquito net given by the state). (*n* = 13; one missing value)	3.64	0.50	3.71	0.47	3.86	0.36
	H.16 In case of serious disease or heavy injury (e.g., measles, fever, a fracture), consulting a doctor, going to a health center or hospital, and following the given advice.	3.79	0.43	3.29	0.61	3.71	0.47
	H.18 Following the measures for good health promoted in the school or the health center (e.g., giving deworming to the pupils, seeking the vaccine).	3.71	0.47	3.36	0.50	3.71	0.50
	Subscales of prevention of (serious) illness	3.71	0.32	3.48	0.39	3.79	0.31
Risk avoidance	H.20 Avoiding exposure to polluted air (e.g., having sufficient ventilation in the kitchen, avoiding the exhaust gas of motor vehicles, avoiding dust).	3.43	0.51	3.77	0.44	3.86	0.36
	H.21 Protecting the body when handling pesticides and other dangerous substances (e.g., using gloves, wearing a working suit, glasses, masks, and shoes).	3.50	0.52	3.21	0.89	3.64	0.63
	H.22 As a pedestrian, paying attention to fast vehicles on the streets (e.g., motorbikes, cars, taxi-brousses).	3.36	0.50	3.86	0.54	3.79	0.58
	H.23 Respecting the security rules when driving a motorbike or a car (e.g., not driving too fast, wearing a helmet on a motorbike, attaching the seat belt if available, using a safe car).	3.43	0.50	3.07	0.48	3.07	0.27
	H.24 Collecting, piling up, and burying unusable waste (e.g., in a precise place outside of the village or city).	3.64	0.50	3.50	0.52	3.57	0.51
	Subscales of risk avoidance	3.47	0.35	3.46	0.50	3.59	0.34

Appendix E. Differences of Adjusted Effectiveness on Course of Action Level—Land-Use Context

Table A5. Paired *t*-test between adjusted effectiveness of the two fields of action in the land-use context. Second Delphi round; *n* (2nd Delphi round) = 15; test statistics: T, degrees of freedom: df.

Topic	Course of Action	Adjusted Effectiveness Biodiversity Conservation vs. Agronomic Productivity			Topic	Course of Action	Adjusted Effectiveness Biodiversity Conservation vs. Agronomic Productivity		
		T	df	*p*			T	df	*p*
Management of vanilla cultivations	L.4	3.81	14	0.002	Soil management	L.1	0.62	14	0.547
	L.5	2.16	14	0.048		L.12	0.63	14	0.536
	L.6	−2.55	14	0.023		L.15	−1.00	14	0.334
	L.7	1.49	14	0.159		L.16	−1.87	14	0.082
	L.8	−0.84	14	0.415		L.18	0.13	14	0.885
	L.9	2.91	14	0.011		L.19	1.85	14	0.086
Management of cultivations other than vanilla	L.2	−2.73	14	0.016		L.20	3.01	14	0.009
	L.10	1.87	14	0.082		L.21	1.83	14	0.089
	L.11	2.43	14	0.029		L.22	1.65	14	0.121
	L.13	1.00	14	0.334					
	L.14	3.98	14	0.001					

Appendix F. Differences of Adjusted Effectiveness on Course of Action Level—Health Context

Table A6. Paired *t*-test between adjusted effectiveness of the two implementation settings in the health context. Second Delphi round; *n* (2nd Delphi round) = 14; test statistics: T, degrees of freedom: df.

Topic	Course of Action	Adjusted Effectiveness Rural vs. Urban			Topic	Course of Action	Adjusted Effectiveness Rural vs. Urban		
		T	df	*p*			T	df	*p*
Clean water, sanitation, and hygiene	H.1	−3.55	13	0.004	Prevention of (serious) illness	H.9	−2.26	13	0.042
	H.2	−3.90	13	0.002		H.11	−1.47	13	0.165
	H.3	−2.77	13	0.016		H.16	−3.10	13	0.008
	H.4	−4.30	13	0.001		H.18	−2.69	13	0.019
	H.5	−2.88	13	0.013	Risk avoidance	H.20	−1.48	12	0.165
	H.12	−2.65	13	0.020		H.21	−2.22	13	0.045
	H.17	−2.67	13	0.019		H.22	1.00	13	0.336
	H.19	−1.69	13	0.114		H.23	0.00	13	1.000
Food hygiene and healthy diet	H.6	−1.28	13	0.222		H.24	−0.56	13	0.583
	H.7	−3.31	13	0.006					
	H.8	−3.47	13	0.004					
	H.13	−5.08	13	0.000					

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