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# Transformative Social Learning for Agricultural Sustainability and Climate Change Adaptation in the Vietnam Mekong Delta

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**Abstract:** Climate change has seriously affected agriculture and many aspects of the life of local people in the Vietnam Mekong Delta (VMD). Learning to shift towards sustainable development to successfully adapt to climate change is essential. The VACB (V—garden/orchard; A—fishing farm; C—livestock farm; B—biogas) model is considered one of the best approaches and methods to adapt to climate change in the VMD. This paper aims to explore the transformative social learning and sustainable development associated with this model in terms of agricultural transformation for sustainability to climate change adaptation in the VMD. The mixed methods approach that guided the data collection included focus group discussions, in-depth interviews with key informants and household surveys. Our findings show that there are three learning processes associated with transformative social learning linked to the VACB model: instrumental, communicative and emancipatory learning. Farmers reported increased knowledge and improved relationships and efficiency when applying the VACB model using several learning channels, both formal and informal. Farmers highlighted six factors that influenced transformative social learning during the adoption and development of the VACB model and several barriers to implementing adaptation strategies to climate change in an attempt to upscale the VACB model.

**Keywords:** transformative social learning; agricultural transformation; sustainability; climate change adaptation; VACB model; Vietnam Mekong Delta

## 1. Introduction

The Vietnam Mekong Delta (VMD) plays an important role in terms of food security and socio-economic development [1]; however, it is one of the regions in Southeast Asia that is most significantly influenced by climate change [2,3]. Developing sustainability, particularly in agricultural and environmental sectors [4,5] is vital, and transformation towards sustainability is considered an important new direction for the Vietnamese agricultural sector in general, and the VMD in particular [6,7]. In the context of climate change adaptation in agricultural transformation, sustainability can be understood as the ability to maintain and improve livelihoods while maintaining or enhancing the local and global assets and capabilities on which livelihoods depend [8–10]. Therefore, learning and transformation processes need to go beyond formal education behind school walls to direct encounters with nature and skills to develop sustainability, which are most effectively learned through opportunities for collective action and reflection [11].

In practice, transformative actions in the agricultural sector are increasingly being required to address changes in climate [12] and participation and empowerment must be key ingredients in efforts to facilitate the learning of more sustainable agricultural practices [13]. Wals and Jickling [14] argued that sustainability can only be created with full and democratic involvement, and with the participation of all members of society. Transformative social learning can, thus, help to foster a more sustainable society [15–17]. Transformative learning is a comprehensive model that can help to examine individual learning processes for information which can be used to help people overcome barriers to adapt to climate change [18–21]. Open and learning-oriented policy systems are necessary with decentralization, consensus building and flexibility that promote productive openness and learning [22]. Studies of the linkages between food security and production show that the climate–water–food–energy–social nexus in the VMD is becoming more seriously affected [16,23]. Local people are interested in different forms of social learning [24,25] to address this, including through public media, civil society, learning of communities, NGOs (non-governmental organizations) and academic or training organizations, and developing their competence in adapting and overcoming the big challenges of climate change and sustainable development [16,26]. Transformative social learning is understood by simply defining social learning with a socially critical orientation, and distilling key elements of social learning that support social change [27,28]. In the climate change context [29], our research shows that transformative social learning also involves psychosocial processes (cognitive [30] and emotional) and potentially, social change [31].

This study seeks to provide an empirical understanding of transformative social learning in agricultural transformation for sustainability in terms of climate change adaptation in the VMD in a VACB (V—garden/orchard; A—fishing farm; C—livestock farm; B—biogas) case study. While some researchers are skeptical about the applicability of transformative learning or social learning [16,23], this study contributes to the current debate on the conceptualization of transformative social learning [28] and provides important evidence of transformative learning taking place in rural communities in the VMD.

The paper proceeds as follows. Section 2 presents a conceptual framework, which explores the transformative social learning concept and the development processes, its roles and the factors influencing the transformative social learning. Section 3 discusses the methodological approach that guides data collection and analysis for the study. The findings of the study are presented in Section 4. In Section 5, we discuss the findings and present a conclusion.

## 2. Conceptual Framework

Transformative learning theory has been growing and changing for almost three decades and it draws on sociology, philosophy and cognitive psychology [10,32]. Transformative learning provides an excellent theoretical framework within which to study adult learners' experiences with technology [33]. In the context of sustainability and climate change, transformative learning may be sustainable from an environmental perspective [34], but it does not adequately consider the developing learners' dynamic qualities that allow them to critique, construct and act with a high degree of autonomy and self-determination [28,32,35]. Learning in the context of sustainability requires hybridity and synergy between multiple actors in society and forms of learning [34]. According to Krasny et al. [36] and Wals [37], a special form of transformative learning that is (re)emerging in governance, natural resource management, environmental education and education for sustainability is social learning. Social learning can be understood as "a process where learning occurs at multiple governance levels, bringing together stakeholders with diverging initial perceptions with the intention to learn together and from a common understanding with respect to taking a planned course of action that they jointly impellent by working in iterative cycles of action and reflection" [26] (p. 37). Thus, transformative social learning can be understood as social learning with a socially critical orientation—it distils key elements of social learning in supporting social change [27,28]. It is considered a potential solution for sustainable development in the present and future [28].

Transformative social learning is important in the context of sustainable development. Transformative social learning for sustainable development, which is focused on collective learning about how to reform policy-making to promote sustainability, is becoming increasingly important [38]. In the context of developing countries and climate, transformative social learning for sustainable development must consider how to ensure economic benefits or potential for livelihood income [39]; how to adapt or be resilient to environmental changes, particularly climate change [40,41]; how to be appropriate for local and state institutions and development policies [42]; and how to be suitable for the capacities of learners and meet their learning needs [43]. Although, in principle, a well-designed transformative social learning can be very useful for dynamic learning and increasing the capacity for the transformation of individuals and the community [44], it also shows that focusing on the learning configuration in the sustainable development context alone is not a sufficient response to climate change. This is critical as it provides individuals and the community with the support needed to improve their livelihood incomes; social, human and market conditions; and social and policy institutions [16,43,44]. Thus, in the developing countries, such as Vietnam, for transformative social learning for sustainable development to be effective, it is imperative to consider the interface between climate, social-economic conditions, market drivers and institutional and policy frameworks, as is creating a dialogical space to facilitate co-creation with different stakeholders in the learning process [26].

There are three domain forms of learning within transformative social learning: instrumental learning, communicative learning [19,44] and emancipatory learning [17]. First, instrumental learning focuses on task-oriented problem solving to help individuals improve the performance of their activities and better achieve their objectives [45]. Instrumental learning includes the acquisition of ecological, social or economic knowledge, legal and administrative proceedings, possible risks of environmental management and adaptation and risk-mitigation measures [8]. Second, communicative learning involves understanding what someone means [9]. It refers to people's abilities to understand their own and others' beliefs, intentions, values, opinions, interests and actions, and to identify commonalities and disagreements [8,46]. Third, emancipatory learning focuses on active dialogue to establish co-owned objectives, shared meanings and a joint, self-determined plan of action to make changes [14,47]. With social learning processes, the learning is supported by participatory methods, which are appropriate mechanisms for realizing more emancipatory learning [17]. All three forms of learning involve critical reflections and critical discourses [33]. Through these processes, individuals critically validate new experiences, opinions and the underlying assumptions that shape perceptions and behaviors [9,10,48].

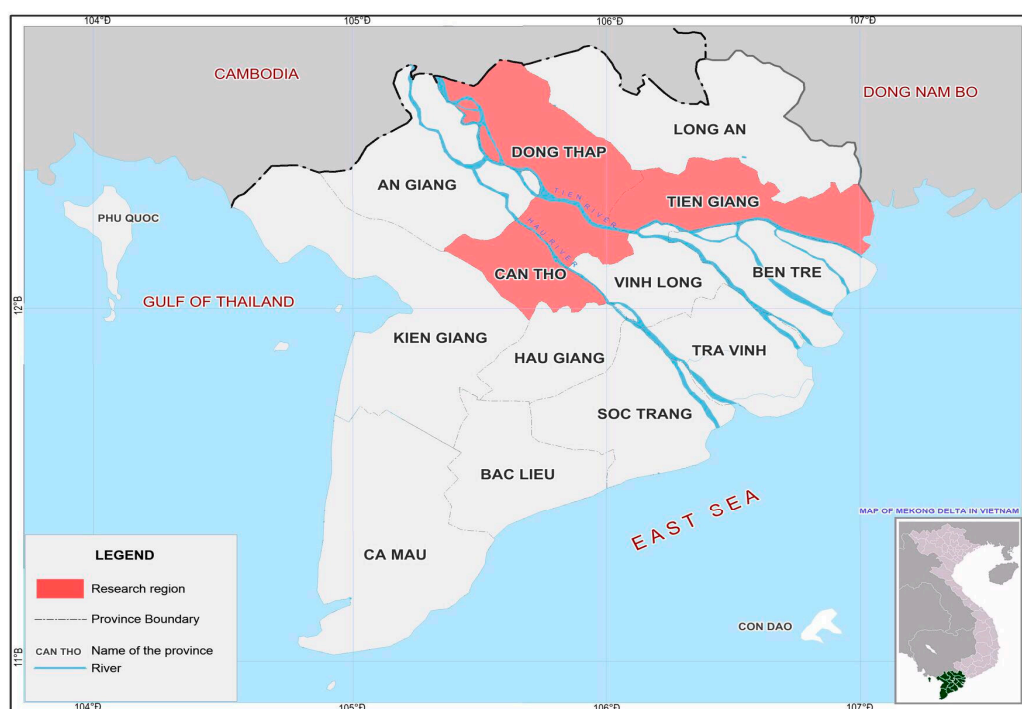
According to Holmberg [49], there are three important building blocks in agricultural transformation for sustainability in terms of climate change adaptation. The first building block focuses on creating a platform for cooperation and information exchange and it needs to be open and flexible. It operates through building trust, maintaining the memory of the change process and giving feedback to relevant stakeholders. The second building block concerns the need to build engagement and involve different individuals through the results of the first block, and additionally, a patient dialogue process based on listening. The third building block is to "communicate the clear commitment of the management team." Key to accelerating the transition are interactions with stakeholders, and building trust, combined with the systematic implementation of incentives and design of structures that cohere with the change process. Transformative social learning has critical contributions to sustainable development, particularly in the agricultural sector [9,50,51]. These contributions include: transforming perspectives, habits of mind and mindsets of individuals or communities [12,30,52], facilitating reflexivity in social learning [10,29,37] and appropriate addressing of climate change adaptation strategies [53]. In addition, transformative social learning contributes to facilitating multi-stakeholder dialogues via several channels [10,17,54] and guiding discourse for the learning process [44,55]. Thus, it can create appropriate conditions for farmers' organizational development [56], facilitating joint learning and promoting innovation [23,57,58] and developing entrepreneurial skills and attitudes [25,59].

Several studies have noted that there are several factors that influence the development process of transformative social learning, such as strong partner facilitation, communication and critical reflection in transforming partnerships [5,32,57,60,61]. In addition, the presence of critical events, the fundamental differences between partners bridged by a common purpose and the retention of personal autonomy, along with dependence on the other partner, are also important factors that influence transformative social learning processes [6,62]. Openness to alternative points of view, willingness to seek understanding and agreement and an acceptance of the results are considered factors that support the creation and enabling of flexible environments for learning processes [32,54,63,64]. Discourses require accurate and complete information; freedom from coercion; an ability to weigh the evidence and assess arguments objectively; and greater awareness of the context of ideas, empathy, concern regarding how others think and feel and an equal opportunity to participate in various roles [30,65]. Moreover, responsive design, implementation and evaluation components are also critical factors that influence effective transformative social learning processes [26]. The ideal end-result of transformative learning is that one is empowered by learning to be more socially responsible, self-directed and less affected by uncertainty and changes [32,56]. Thus, transformative social learning is believed to be important for flexible decision-making and autonomous thinking, making it advantageous for responding to changing environmental conditions [9,66], particularly in the climate change adaptation context [9,10,67].

### 3. Methodology

#### 3.1. Selection of Study Sites

Can Tho city and Dong Thap and Tien Giang provinces were selected as study sites for this research (Figure 1). Can Tho is located near the center of the Mekong River, where many universities are located, such as Can Tho University, and it was here that the VACB model was first applied in the Mekong Delta [16]. The VACB model was initiated in Can Tho in the last decades of the twentieth century under the technical and financial support of the Rural Development Project based on the clean development mechanism funded by JIRCAS, Japan (Phuong & Tuan 2018). The VACB is a livelihood model combining three elements (V–A–C) with the construction and exploitation of gas from biogas digesters (B). Dong Thap province is well known for the development of social learning using the communities as practice models. There, a volunteer group that shared an experimental farm was supported by the local government, and created a platform for the farmers' learning process. They also helped to connect businesses, scientists and farmers. The third area is Tien Giang province, where several well-known farmers have been successful with the VACB model. In addition, the Mekong Delta has been impacted by climate change in general, and in three study areas, in particular [16]. The government and local authorities, as well as farmers, have adapted and converted several sustainable agricultural models for coping with the environmental and market changes in general, and climate change, in particular. Therefore, these areas represent special areas for transformative social learning processes related to climate change and sustainable development in the Mekong Delta.



**Figure 1.** Map of three study sites: Can Tho, Dong Thap and Tien Giang.

### 3.2. Data Collection and Analysis

Semi-structured interviews were the primary source of data collection. Interviews were conducted from August to December 2018 in Can Tho, Dong Thap and Tien Giang. There were three criteria used to select farmer interview respondents: (1) the respondents had to have worked with the VACB model; (2) they must have had experience for at least five years in mixed crop farming and livestock production; (3) they must have participated in at least one civil society organization in the community. In total, 120 households (10% of all farmers who have implemented the VACB model in three study areas) were randomly selected for interview invitations. Each interview took between 45 and 60 min. Interviews focused on the following main topics: forms of transformative social learning; roles and contributions of transformative social learning; factors and barriers influencing the development of the transformative social learning. In order to gain the advantages of distinguishing three forms of transformative learning, we categorized questions as follows: questions related to improving knowledge and awareness of climate change, the effects on the sense of urgency regarding climate change and adaptation, the changes in actions to the effective application of adaptation practices, and the changes social and economic knowledge that were considered an instrumental form of learning; questions related to farmers' abilities to make their decisions and their actions in practice, which were considered a commutative form of learning; and the questions related to creating networks, learning interactions and the reasons for changes in practices, which were considered the emancipatory form of learning.

Data from semi-structured interviews were coded and further analyzed using SPSS through several steps. First, the contents of all interviews were checked basing on objectives of this study. Second, we clustered the collected data based on topics mentioned above. Then, quotes were selected that directly spoke to the key questions being asked in the study. The most frequently reported factors, barriers and roles were discussed and crosschecked with the secondary data. This analysis was helpful for exploring the types and outcomes of transformative social learning, as well as what supported transformative social learning in the three study research areas. Descriptive statistics were used to present the rates and percentages of farmers' answers.



To understand transformative social learning processes, a small number of in-depth interviews seemed more appropriate than a large sample of questionnaire surveys. In total, 22 key informants in three study sites were interviewed. Face-to-face interviews [68] were conducted using a structured guide and each interview took at least 60 min. Interviewees included key farmers, members of government, scientists and businesspersons that had contributed to the development of transformative social learning in the Mekong Delta related to the VACB model. The main topics for the interviews included how farmers could gain experiential knowledge and how they could make decisions based on transformative social learning. There was a focus on how transformative farmers could become 'germ-cells' for the transformative social learning process, how transformative government could contribute to transformative social learning in the Mekong Delta, and how scientists could work with transformative social learning as a participatory approach for transferring knowledge and technology. In that case, transformative government focused on the changes in policies, management and support of local government in promoting and supporting the development of sustainable agricultural models with adapting to climate change in the Mekong Delta. The interview data was analyzed using open coding and by identifying topics which were clustered according to the themes: three forms of learning, contributions of transformative social learning, and factors and barriers influencing the development of transformative social learning.

Five focus group discussions were conducted with 6–10 key informants, both men and women, to explore the results from in-depth interviews and semi-structured interviews. The influences of transformative social learning in agricultural transformation for sustainability to climate change adaptation in the Mekong Delta, particularly linked to the VACB model, were noted. Focus group discussions lasted about two hours. Focus group discussion reports were written and condensed using data reduction methods and thematic analysis [69].

## 4. Findings

### 4.1. Three Forms of Transformative Social Learning in the Process of Developing the VACB Model: Instrumental Learning, Communicative Learning and Emancipatory Learning

As part of the transformative social learning process, several phases appear to be important for challenging the existing frames of reference, to bring in new forms of understanding that lead to changes in intention, behavior and action. The findings of this study show that instrumental learning, communicative learning and emancipatory learning happen simultaneously in the process of building the VACB model. In instrumental learning, farmers get knowledge and information about the VACB model. By means of communicative learning, farmers observe successes within the VACB model and share their experiential knowledge with others about their own work using the VACB model. Finally, using emancipatory learning, farmers make decisions on whether to apply the VACB model. The amalgamation of these processes contributed to the development of transformative social learning in the study communities.

The results showed that the majority of respondents (79%,  $n = 95$ ) accessed and received knowledge and information via instrumental learning. This included knowledge and awareness of climate change, a sense of urgency about climate change and adaptation, changes in actions based on effective adaptation practices and social and economic knowledge that related to the VACB model and local environment. Almost all the respondents (98%,  $n = 118$ ) indicated that they had made several changes to their agricultural production based on communication learning. These changes were adaptation measures to climate change for the VACB model. They included adjusting the crop patterns, using drought-tolerant crops and livestock, applying the integrated production models as crop rotation to reduce diseases risks, applying production techniques to adapt to climate change in the VACB model or applying techniques in save-water. They explained that this kind of learning involved sharing knowledge and information, and social experiences. Through several learning channels, particularly dialogue between farmers; discussions with neighbors and friends, informal talking and sharing and self-learning, farmers had increased their interest in media coverage of climate change and

significantly changed their knowledge and awareness of climate change, which had an impact on their farms' production models. The communicative learning facilitated by group discussions also led to higher engagement in decisions of farmers regarding adaptation measures in the VACB model. Most respondents (85%) engaged in emancipatory learning through exploring, asserting themselves, freeing themselves and their families from obstacles and were determined to implement the VACB model. The critical aspect of emancipatory learning among farmers and other stakeholders was highlighted after discussions in the communicative learning phase through the instrumental learning channels. This focused on finding appropriate solutions or measures for adaptation in the VACB model in relation to the production system and marketing issues of farmers.

#### *4.2. The Roles of the Transformative Social Learning during the Adoption and Development of the VACB Model*

The majority of farmers (74%,  $n = 89$ ) in our study communities said their involvement in several rounds of the transformative social learning process had improved their thinking, understanding and attitudes regarding the challenges of climate change and sustainable livelihood development. Among many stakeholders in the VACB model, an increased interest and awareness about climate change was the result of instrumental learning and an improved understanding of climate science. Interviewees noted that several learning channels had influenced and increased their personal awareness and knowledge about climate change. Thus, the transformative social learning process is evident in promoting dialogue, exchange, sharing knowledge and experience between farmers and related stakeholders, and the VACB model can be adapted for working with climate change (70%,  $n = 83$ ). Communicative learning that was facilitated by group discussions led to engagement with the VACB model for climate change adaptation. The data from the study suggested that trust in climate science was of key importance for stakeholder learning and engagement with adaptation. Many respondents (63%,  $n = 74$ ) noted that transformative social learning can contribute to establish and unify the values of sustainable development and consolidating the trust and relationships of farmers and local authorities in adopting and developing the VACB model. In addition, transformative social learning has an important role in enhancing community engagement and connecting 'four houses'—the state, the scientist, the farmers and the businesspersons ( $n = 66$ )—and supporting changes with regard to sustainable attitudes, behaviors and lifestyles in the context of climate change ( $n = 67$ ). In particular, several respondents mentioned the income efficiency of applying the VACB model. Through the VACB model and transformative social learning processes, 91.7% of respondents understood that environmental benefits are critical for ensuring economic benefits in the long-term. Economic benefits, through increasing income (83.3%) and reducing fuel costs (84.2%), were also the results of effective learning together among farmers and other stakeholders through three kinds of learning: instrumental learning, communicative learning and emancipatory learning.

#### *4.3. Factors Influencing the Transformative Social Learning Process during the Adoption and Development of the VACB Model*

Focus group discussions and in-depth interviews revealed six factors that influenced the transformative social learning process during the adoption and development of the VACB model (Table 1). These factors were used to interview 120 farmers to check the response of farmers. The first factor was financial support from the government and non-governmental organizations to households for developing the VACB model ( $n = 25$ ). This factor seemed to be important in previous studies concerning sustainable livelihood model development [16,23]. However, in this study, only 21% ( $n = 25$ ) of respondents mentioned this factor and most claimed that this factor had almost no effect on the development of the VACB model.

**Table 1.** Factors influencing the transformative social learning process during the adoption and development of the V—garden/orchard; A—fishing farm; C—livestock farm; B—biogas (VACB) model.

#	Factors Influencing the Transformative Social Learning Process	Respondent (n)
1	Financial support from the government and non-governmental organizations to households for developing the VACB model	25
2	The training and supporting techniques of scientist and consultants	62
3	Involved social learning in communities of practice with key farmers	62
4	The benefits from the VACB.	104
5	Experiential learning within successful models in the community and flexible forms of experiential learning	102
6	The close connection among four stakeholders in the transformative social learning process	101

The second factor was the training and supporting techniques of scientists and consultants. Several respondents ( $n = 62$ ) reported that they had gained knowledge and motivation for applying the VACB model via training from universities and institutes during training courses or visiting tours, and with support from extension workers or researchers.

The third factor involved social learning in communities of practice with key farmers, who are ‘germ cells’ and key in creating and maintaining transformative social learning processes during the adoption and development of the VACB model ( $n = 62$ ). Of the respondents, 52% claimed they had been informed about the VACB model by key farmers. Key farmers appear to create and strengthen the trust of farmers to adopt the VACB model in the Mekong Delta. The VACB model was introduced to 86% of respondents by key farmers whom they trusted, while only 20% of respondents were introduced by others (such as T-government, T-teachers or T-supporters). Thus, farmers appear to trust other key farmers more than other stakeholders. Key farmers, therefore, have an important role in the upscaling of the VACB model.

Many respondents ( $n = 104$ ) indicated that they learned about the benefits only after adopting various practices. Results from group workshop discussions showed that they often learned about economic benefits which led to their initial adoption of different practices. In applying the VACB model and during the transformative learning process, 85% ( $n = 92$ ) of respondents came to know and understand that environmental benefits are critical for ensuring economic benefits in the long-term. However, currently, environmental benefits are not usually the only factor driving change.

Experiential learning within successful models in the community and flexible forms of experiential learning have led to real change and transformation in individuals and communities towards sustainability ( $n = 102$ ). The study of Phuong and Tuan (2018) showed that experiential learning is a key factor in the approach and application of the VACB model in Can Tho. This conclusion is true throughout the Mekong Delta. Of the respondents, 53% ( $n = 64$ ) achieved their knowledge by participating in a successful VACB model. Flexible channels for transformative social learning mean that farmers can obtain their knowledge from books or from information and communications technology, such as smart phones, the internet, television or radio. They can also get information from teachers or they can learn from other provinces. The flexible forms of experiential learning have also led to real change and transformation in individuals and communities towards sustainability.

A final factor to consider is the close connection among four stakeholders in the transformative social learning (T) process that has occurred in three study areas ( $n = 101$ ). They include T-government, T-teachers (scientists or experts), T-learners (farmer) and T-supporters (enterprises, agricultural extension associations, and women and youth associations) in the VACB model. All four stakeholders are part of the VACB model. T-learner stakeholders—the main determinants in the transition—must acquire their own knowledge, have their own experiences and liberate themselves. Only those who constantly study and experience for themselves will change and succeed and improve their quality of



life. T-government promotes the learning and transformation process of the farmers through policies, financial capital support and organizing community activities for farmers. T-teachers deal with new knowledge to help farmers adapt to climate change, and T-supporters regulate the market and produce and transfer products to farmers. Concerning the role of these factors in the process of transformative social learning, farmers felt that T-farmers and T-teachers were the most important factors (49%,  $n = 59$ ) in contributing to the development of sustainable livelihood models as in the VACB model.

#### *4.4. Barriers to Upscaling the VACB Model through the Transformative Social Learning Process*

Respondents experienced various barriers in upscaling the VACB model through the transformative social learning process. The most important barriers related to lack of knowledge and experience to effectively build and operate the VACB model, especially with regard to gas-composting tunnels ( $n = 72$ ). About half the respondents mentioned the lack of financial capital investment to develop and extend the VACB model ( $n = 46$ ). They explained that the development of the VACB model is associated with renovating and changing inappropriate livelihood models. It requires significant investments in terms of effort, time and funding, while most households in communities lack financial capital for production activities. More than one-quarter of the respondents ( $n = 34$ ) indicated that the lack of trust among farmers, along with prevailing local norms and practices, kept them from making changes. Applying the new livelihood model requires trust among different stakeholders, especially between farmers and between farmers and local government. Although there was assistance from the local government and agricultural extensions, and the scientists at universities, farmers noted that the lack of institutional capacity ( $n = 22$ ) to facilitate applying new agricultural adaptation models at the household level created an important barrier. Changing the awareness, understanding and thinking, and creating a new way of life that supports the environment and sustainable development are critical for overcoming these barriers. The most important barriers relate to difficulties in selling products locally, resulting in a lack of secure household income. Fluctuations in the local market price ( $n = 20$ ) were considered to be the primary reason for a change in practices, while environmental benefits were secondary.

## **5. Discussion**

Transformative social learning can help to foster a more sustainable society and involves instrumental, communicative or emancipatory learning [15]. Adult education theories of transformative learning and critical reflection from a critical theory perspective are particularly pertinent to inform this type of transformation [30,70]. Alternative learning models in the extension of education emphasize design and stress adult learning and its facilitation [16,23,44]. Transformative social learning focuses on three domains of learning: instrumental, communicative and emancipatory learning [17,33]. Based on evidence from this study, instrumental learning is governed by rules and learning channels. Communicative learning emphasizes interactions or “chat rooms” which share practical learning. Emancipatory learning emphasizes self-decisions of learners who apply their knowledge, as well as their beliefs on technology, within their social systems of learning. However, the findings of this study emphasize that three forms of transformative social learning have not been enough to promote sustainable development in the climate-change adaptation context. Multiple factors must be incorporated into the three forms of learning, such as financial support, training and supportive techniques, the roles of key farmers, particular economic benefits of models, successful models and flexible forms of learning and close networks with multiple stakeholders, support the learning processes more effectively. According to Wals [28], transformative social learning emphasizes learning for being, learning for knowing, learning for doing and learning for change. Education and learning for sustainability involve the creation of space for transformative social learning [28]. Therefore, our study can contribute and help to effectively increase the participation and motivation of different stakeholders in transformative social learning processes.

The farmer is seen as an expert and farm development is driven by farmers' energy and communication [50]. A shift to knowledge-intensive sustainable practices requires a learning process based on participation and empowerment [32]. The lack of an understanding of the social, economic and environmental conditions prevailing at the time of transformative change, the complexity of the associated decision-making processes and the relevance of temporal and spatial scales to enabling adaptation, highlights a knowledge gap in the information needs and policy support required by stakeholders in the primary industries [12]. Therefore, learning is motivated by its economic and social value to the learners in sustainable agricultural development [9,57,71]. In addition, to improve the effectiveness of transformative social learning, the exchange of experiences and learning needs to be promoted, which requires improved coordination among different stakeholders in the learning processes.

This study also supports earlier work showing the roles of transformative social learning in sustainable agricultural development and the importance of learning and engagement with adaptation in the VMD [16,23]. Understanding how learning occurs is important for facilitating sustainability in agriculture [72]. The effects of transformative social learning can help us understand, in more detail, the learning processes and changes in perspectives that must take place for environmental changes (such as climate change) or market changes [32,44]. Therefore, transformative social learning promotes farmers' understanding of market dynamics—demand and price trends, quality standards, business lines and environmental requirements to sustain business activities [16,23,25]. In the sustainable agricultural development context particularly, it provides insights into how extension workers (called transformative teachers) can facilitate this critical shift and under what circumstances this is appropriate [8,44,57]. This has implications for the training of extension workers and scientists who may be involved in participatory activities in communities directly with farmers [9,16,32,73]. Therefore, transformative social learning and its contributions to agricultural transformation to sustainability in the context of climate change are identified as enhancing the adaptive capacity of individuals and communities [12], shifting to more sustainable practices and adopting the new practices [35]. Furthermore, it can set a path for the further premise-based reflection of farmers [74], enhancing communicative competence and social change, gaining insight into one's own learning style and driving information for transformative social learning [9,10,50].

The study also emphasizes the role of personal experiences (T-learners or germ cell farmers) in shaping stakeholders' frames of reference and learning with regard to adopting the VACB model and climate change adaptation. The farmers and other stakeholders, such as local authorities, were motivated to learn and engage with climate change adaptation when they saw the link between the scientific knowledge discussed and the benefits, including economic, environmental and social, through different learning channels (instrumental learning) and informal and formal discussions (communicative learning). This is related to single-loop and double-loop learning and changing behaviors [75,76].

Sustainable agriculture is not an 'innovation' that farmers 'adopt.' Changing to more sustainable practices is more like a paradigm shift, involving a learning path leading to new perspectives on risk avoidance, new professionalism and a greater reliance on one's own expertise and observations [60]. The use of new indicators and new instruments to make things visible, and usually, greater dependence on collective decision making in cooperation with other stakeholders in the same ecosystem, are all important. Facilitating such a learning process seems very different to regular extension work [27]. Instead of relying on external expertise and inputs, farmers are empowered to rely on their own judgments and observations. Instead of transferring blanket recommendations, such facilitation seeks to enhance each farmers' expertise and skills in observation and (collective) decision-making [23]. The paradigm shift involved seems easier when learning is experiential and occurs together with other farmers. This calls for participatory and group approaches in extension work.

## 6. Conclusions

This paper supports existing argument(s) that transformative social learning for sustainability is key to enabling adaptation and resilience to climate change. The depth of this learning impacts the effectiveness of its bringing about the transformations of perceptions, knowledge and actions. Three forms of transformative social learning were discussed: instrumental, communicative and emancipatory learning. Transformative social learning has critical roles for sustainability in the VMD. Farmers reported increased knowledge, improved relationships and improved efficiency of applying the VACB model through several learning channels that were both formal and informal. Six factors were found to influence the adoption and development of the VACB model: financial support from the government and NGOs; training and supporting techniques of scientists and consultants; social learning in communities of practices with key farmers; benefits from the VACB; experiential learning in successful models in the community and flexible forms; and close connections between the four stakeholders. Farmers reported several barriers to implementing adaptation strategies to climate change in order to upscale the VACB model, including lack of knowledge and experience, lack of financial capital investment, lack of institutional capacity, lack of trust among farmers and fluctuations in local market prices. Understanding how transformative social learning occurs is important for facilitating sustainability in agriculture. Therefore, fostering conditions that are conducive to learning and particularly, transformative social learning, means farmers would probably be more open to new ideas and practices that promote sustainability and adaptation in the context of climate change, which is important for developing the knowledge required to build adaptive capacity.

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