

Transition of agroecology in Bali, Indonesia

What are the main barriers and opportunities for small-scale farmers to scale-up agroecology in central Bali?

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Barriers and opportunities for small-scale farmers in the transition to agroecology in central Bali, Indonesia

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Abstract

Since the late 1960's, the Green Revolution introduced high yielding varieties in association with agrochemicals to address increasing food demands across Southeast Asia. Indonesian government extended these "technological packages" through political incentives replacing traditional farming methods to stimulate agricultural productivity and economic growth. Besides contributing to Indonesian economic development and reducing food insecurity, the adoption of those technological packages led to many negative externalities, such as soil degradation, water pollution, loss of biodiversity, destruction of natural habitat, increased dependence on artificial inputs and non-renewable resources, and more importantly loss of local control over agricultural production. Different farming approaches internalizing socio-ecological aspects of food production have increasingly been recognized by the FAO as better alternatives.

Agroecology is a transdisciplinary farming approach, bridging social, biological and agricultural sciences while including traditional farmers' knowledge. Despite extensive evidence in favor of agroecology, the various interests of actors of the agrifood system hinders its large adoption. Although small-scale farmers (>2ha) represent the majority of the world's food production, their influence on the production system is limited.

The island of Bali represents an accelerated version of a global problem: increasing pressure on limited land-based resources along with liberal policies. Rapid urbanization due to mass tourism is causing 1000 ha of arable land to disappear every year and heightening water shortages, crippling Balinese century-old food sovereignty. This thesis explored through an agroecological lens the multiple challenges Balinese farmers are facing in the transition to agroecology. An important factor identified was the loss of traditional farming knowledge as younger generations were abandoning farming activities because of low profitability. Furthermore, inadequate political support and enforcement have been reported to hinder the development of sustainable agriculture in Bali. The study also identified that growing awareness, a good access to markets and how social networks to spread sustainable farming techniques can potentially make farming more attractive and viable. Policies that will better adapt to Balinese context from small-scale farmers' perspectives were also shared and discussed.

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Forward

I remember my grandfather spending hours working in his vineyard at the foot of the Swiss Alps. His passion for Oenology was admirable. I would venture his vineyards and wine cellar, which felt like a museum but looked like a lab, filled with barrels, unlabelled bottles, and smells of sulphites. I was intrigued as he regularly sprayed what seemed to be toxic chemicals on the grapes, since he was wearing protective clothes. Although I understood it would protect the fruit from pests and enhance production, it was confusing. To me it did not make sense to spray harmful agrochemicals on grapes, shortly before harvest, then adding more chemicals, before finally drinking it. It seemed obvious that anything you would put on the fruit would eventually end up in nature and in your body. Yet, everybody in my circle of friends & family who works in the wine industry proceeds that way. I believe that is what unconsciously triggered my interest in sustainable agriculture.

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Abbreviations

FAO	Food and Agriculture Organization of the United Nations
IFOAM	International Federation of Organic Agriculture Movements
NGO	Non-Governmental Organization
NI	Navdanya International
PGS	Participatory Guarantee Systems
SDG	Sustainable Development Goals
SSF	Small-scale farmer
THK	Tri Hita Karana Bali Foundation

1. Introduction

1.1. Global context

On July 29th, 2019, the world's population had already consumed all resources that the Earth was capable of regenerating during that year (Global Footprint Network, 2018). Even if the ability of ecosystems to renew themselves, called biocapacity has increased by 27% (WWF, 2018) during the last 50 years through better land management and technology, it cannot keep pace with humanity's growing consumption. During the same time frame, the latter has raised by 190% (ibid). The demand for food makes up to 26% of these consumed resources (Global Footprint Network, 2018), therefore the way food is produced has to be further improved, if sustainability is to be achieved.

Meeting the food demand for the growing population was the main justification for the Green Revolution (GR) introduced in India and Indonesia in the early 60's and 70's respectively (Hansen, 1971; Shiva, 2016; Chakra, 2019). The Industrial agriculture which followed aimed at maximizing production and profit, which increased productivity, but led to many negative consequences. These are referred to "externalized costs" or "externalities" in conventional economic terms (Gliessman, 2015). Negative externalities include soil degradation, overuse of natural water supply, environmental pollution, loss of biodiversity, destruction of natural habitat, increased dependence on artificial inputs and non-renewable resources, loss of local control over agricultural production to name a few (Gliessman, 2015; Shiva, 2016). Farming became specialized, mechanized and dependent on non-renewable agrochemical inputs (ibid). Decades later, it is now established that industrial farming is extremely vulnerable to climatic shifts, intense weather events, proliferation and resistance of pests and diseases due to monocultures, which might increase productivity by reducing labour and increasing technology-based inputs, but makes farmers dependent on those expensive artificial inputs, without which it is difficult to grow crops (Gliessman, 2015). Other side effects are increased fragility and high resource requirements of genetically modified plants, not to mention groundwater and soil pollution due to high fertilizer inputs and the loss of genetic diversity (Gliessman, 2015; Smith,

2003). To summarize, the more “developed” countries become, the more industrial and the more intensive farming techniques they adopt, which is contradictory at its core, since it deteriorates the ecosystems that makes agriculture possible in the first place (ibid). Consequently, problems caused by high-tech standardized agriculture will probably not be solved with the same approach that caused them. Therefore, growing evidence suggests that integrating socio-economic and ecological principles could address the aforementioned externalities and perhaps promote more sustainable food systems.

Agriculture is at the interface of Humanity and Nature, which has allowed humans and societies to grow and thrive. Throughout history, the rise and fall of civilizations have been closely dependent on their capacity to effectively adapt their land management techniques to their environments (Montgomery, 2007). The way food is produced has the capacity to reduce hunger, generate income and employment, mitigating global warming, and increase resilience to future climate changes (FAO, 2018; Pachauri *et al.*, 2014). In order to face the aforementioned global problems, the Food and Agricultural Organization of the United Nations (FAO) defined sustainable development goals (SDG). These include eradicating world hunger, reducing extreme poverty by increasing livelihood through higher employment among other objectives which can all be addressed by the body of actors in the food system (FAO, 2018). Promoting and accelerating the uptake of more inclusive farming practices is an important step to address several of the current and future challenges in agricultural development (FAO, 2018 & 2014; Altieri, 2015; Gliessman, 2015).

Natural and artificial ecosystems are diverse and complex, yet they obey universal laws of thermodynamics, particularly energy flow and nutrient cycling, which are yet unchallenged (Gliessman, 2015; Whitten *et al.*, 2013). The study of Ecology permits to predict and potentially improve ecosystems. Permaculture and agroecology aim at mimicking those natural cycles, reducing artificial inputs and designing food production systems, which are the most adapted to a specific environment with its own ecological characteristics (Mollison *et al.*, 2011; Gliessman, 2015 & 2016). Agroecology is a science, practice and social movement that bridges traditional knowledge, positivism and socio-political values to enhance the livelihood and environment of its practitioners (Laforge *et al.*, 2018; Méndez *et al.*, 2017; Gliessman, 2016 & 2015; Altieri, 2015; Wezel *et al.*, 2014). This transdisciplinary perspective seeks to reinforce ecological synergies by integrating crop rotations, agroforestry and animal husbandry suitable to specific environments (ibid). Each agroecosystem is designed in consideration of unique needs and conditions, so that ecosystem services and natural resources, on which productivity relies on, can be maintained and

improved over time (Méndez *et al.*, 2017; Gliessman, 2016 & 2015; Altieri, 2015; Wezel *et al.*, 2014). Permaculture and agroecology share these fundamental concepts and have also increasingly been recognized in the last decades by farmers and institutions around the world as a sustainable way of farming (Montgomery, 2007; Mollison *et al.*, 2011; Altieri 2015; FAO, 2018 & 2014).

Agroecology can be seen as a toolbox containing all agricultural techniques, first analyzing the problem in its multidimensional complexity to then improve the production system with most adapted tools. Moreover, if all farming methods are classified along a sustainability spectrum, which includes three dimensions of sustainability (social, economic and ecological), it would look similar to Figure 1. The latter not being an extensive and precise comparison as it depends on the methods of measurement but providing visual support to grasp the concept of slowly moving towards more sustainable practices, thus food production systems. The idea is to increase energy efficiency of industrial methods before gradually substituting them with more sustainable methods and finally redesign the whole agroecosystem (Gliessman, 2015).

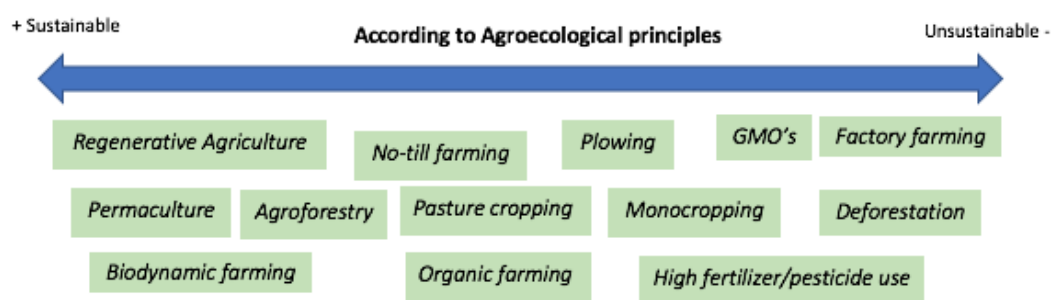


Figure 1 - Sustainability spectrum of farming practices

For simplification of this research, I used the terms Agroecology, Permaculture and “more sustainable agricultural practices” interchangeably depending on the interviewee’s familiarity. Although these are very different in practice, from an epistemological perspective many concepts overlap, providing holistic solutions, which seek to incrementally climb the ladder, spectrum of sustainability.

1.2. Background

The drivers of this research are based on three established facts. Firstly, the interrelationship of global crises humanity is facing - energetic, economic and ecological (Altieri, 2015). Besides climate change, ocean acidification and soil erosion among many others, which are correlated with rising levels of atmospheric carbon dioxide, peaks of overall consumption and loss of

biodiversity, which already led to system-level collapses in many industries like fishery and forestry (FAO, 2018; Altieri, 2015; Behnassi *et al.*, 2011). Furthermore, those collapses are combined with socioeconomic issues like hunger, ecological migration, poverty and inequalities to name a few (*ibid*).

Secondly, among 570 million farms around the globe, 475 million are small-scale (up to 2 hectares) subsistence farmers (FAO, 2018, p.3), which represents more than 80% of all farms, but only 12% of total farmland. In other words, small-scale subsistence farmers feed the world's population and therefore need assistance in greater numbers in the transition to agroecology.

Thirdly, even if population would stabilize, the growing consumption imposes the necessity to continuously increase agricultural productivity with decreasing amount of arable land and land-based resources (iPBES, 2019; Altieri, 2015; Behnassi *et al.*, 2011; Myers *et al.*, 2000).

Industrial and conventional agriculture have been promoted and subsidized by governments and multinational companies since the 60's. These intensive farming methods are defined as high-yield, high-input synthetic agrochemicals along with "top-down" research and extension approach of practicing agriculture (Gliessman, 2015; Filson, 2005). It certainly increased productivity through heavy external inputs but has now reached a plateau (*ibid*), on top of the aforementioned negative externalities. Moreover, the COVID-19 crises exposed the vulnerability of global food supply chains associated with industrial agriculture and propagation of zoonotic viruses (iPES, 2020).

As each agroecosystem combines its own specific socio-economic and ecological characteristics, a multidimensional and inclusive approach appears more cautious (Gliessman, 2015). The multidisciplinary approach of agroecology combines indigenous knowledge and latest research with aim to increase productivity, mostly relying on ecosystem services. The real challenge is to increase its adoption (FAO, 2018). Moreover, as small-scale farmers are the ones practicing agriculture in larger numbers on top of being the most vulnerable to upcoming climate irregularities (FAO, 2018; Pachauri *et al.*, 2015), the most effective and urgent strategy to promote sustainable development is to assist those farmers in the adoption of agroecological practices. Transitioning to agroecology will have incremental benefits on farm, regional and global levels besides reaching the Sustainable Development Goals (SDG) identified by the FAO (2018).

1.3. Bali as the study location

The drivers of the research align perfectly with Indonesian, more specifically Balinese context. Indonesian independence was recognized in 1949 and its development encountered many sociopolitical, economic and environmental

obstacles. In the last 70 years the country has seen rural exodus, periods of authoritarian regimes, economic crises, food insecurity, the GR, terrorist attacks, and alarming loss of biodiversity, to name a few (Whitten *et al.*, 2013; Hitchcock *et al.*, 2007; Lansing, 2006; Myers *et al.*, 2000).

According to Whitten *et al.* (2013, p.560) “Rice is not just food - it’s a culture, a way of life”, which underlines the importance of rice cultivation in Indonesia. Rice cultivation is well suited to Indonesia’s tropical climate because of its favorable rainfall and availability of cheap labor (Whitten *et al.*, 2013). With over 270 million inhabitants (FAOSTAT, 2020) to feed, each of them consuming on average 150 kg of rice per year (FAOSTAT, 2002), Indonesia has become one of the largest rice producers in the world after China and India (FAOSTAT, 2020).

After Sukarno was removed from his functions in 1967, along with the communist party, Suharto’s “New Order” (1966-1998) pushed for economic prosperity. In order to do so, two main strategies were adopted: 1) creating more employment in the industrial and service sector; 2) increasing agricultural productivity. Agriculture’s contribution to Indonesian gross domestic product has oscillated around 25% in the 1970’s and early 1980’s (Frederick *et al.*, 1993) to 12.8% in 2018 (WorldBank, 2020). Meanwhile, the share of agriculture in the total labor force dropped from above 50% in the 1970’s (Frederick *et al.*, 1993) to 29% in 2019 (WorldBank, 2020). Structural change is observable as it progressively moves from agriculture to manufacture, to services.

During the New Order, like in many other developing countries, Indonesia designed her food production programs to increase yield. During this time the GR was gaining popularity and seemed very promising to reach the national objectives of self-sufficiency in food production and economic progress. During the late 60’s Suharto implemented a farming program called “BIMAS” providing fixed packages on credit of seeds, fertilizers and pesticides (Hansen, 1971). Those strategies developed in urban areas and extended by government actors to subsistence farmers were not well received. Although farmers may seem irrational and conservative to refuse adopting innovative techniques to increase productivity, traditional rice cultivation methods have been designed and evolved over centuries (Lansing, 2006), thus inherently being sustainable as they evolved according to human needs and ecological limits. Nevertheless, the growing demand for food while using the same amount of arable land with less land-based resources implies the necessity to increase agricultural productivity. According to agroecology, learning indigenous rice cultivation methods could permit ecological intensification of rice cultivation within the natural limits of an agroecosystem.

Among thousands of islands of the Indonesian archipelago, Java and Bali have become the largest contributor to the national gross domestic product (Whitten *et al.*, 2013). Since first colonization in 1511, by navigator Antonio de Abreu,

followed by Dutch hegemony at the end of the 16th century, Bali has been perceived as a paradise island, attracting millions of tourists over the years (Vickers, 2013; Hitchcock *et al.*, 2007). Bali has been at the center of attention of foreign investors and Indonesian political stakeholders. Despite opposing views of Indonesian leaders Sukarno and Suharto to current Joko Widodo, all acknowledged the island's importance in regard to Indonesian development.

The island is mostly known for its breathtaking landscapes along with its diverse and warm culture (Hitchcock *et al.*, 2007). Even the United Nations Educational, Scientific and Cultural Organization (UNESCO) recognized the Balinese traditional rice terraces as world heritage with outstanding universal value, worth being preserved. Indeed, Lansing (2006) meticulously studied the interactions and respective role of the social and ecological dimensions in the development of those irrigated rice terraces. His anthropological insights combined with solid ecological evidence provides an in depth understanding of the complexity of the self-organizing process of Balinese century old rice terraces.

Cooperative management of rice terraces within villages extended to whole watersheds, creating the subak irrigation system (Lansing *et al.*, 2017). It is a perfect example of the intertwining process of farming, as it includes social, political and ecological aspects. Since there are only two seasons, wet and dry, peasants could in theory plant at any time. However, in order to equally distribute water to fields, democratic assemblies would discuss and schedule planting techniques as a community. Moreover, given the small adjacent rice paddies, every pest outbreak or other issue faced by one farmer would become everybody's problem. The feedback loop between the ecology of rice paddies and social structures is what shaped the Balinese landscape over centuries (*ibid*). Based on equal access to land-based resources with aim at maximizing productivity within ecological limits, created a resilient bottom-up crop management (*ibid*), which is comparable to agroecological principles.

It is unclear when exactly irrigated rice cultivation started in Bali. Some argue it was practiced before Indian influence in the first century (Wisseman, 1993), while others claim it was introduced shortly before the Majapahit Kingdom during the 13th century (Whitten *et al.*, 2013). Either way, it appears that once rice terraces were used, Balinese maintained, and perfected that type of production system over generations (*ibid*).

Over half of the rice fields in Bali are irrigated, one quarter is rainfed and other quarter are drylands using constructed canals (Whitten *et al.*, 2013). It is often believed that rice cultivation requires large amounts of water, when in fact, the crop tolerates it (*ibid*). The flooding of rice fields facilitates weed control by drowning undesired roots during the growing cycle of the rice. Moreover, it has

been observed that water maintains soil particles together to avoid erosion of steep terraces (ibid). To complete the natural cycle of nutrient depletion the blue algae, naturally present in the water and containing cyanobacteria, converts atmospheric nitrogen (N₂) into ammonia (NH₃), nitrates (NO₂) and nitrites (NO₃), which makes it bioavailable to the plants. The nitrogen fixing blue algae has thus allowed farmers to repeatedly cultivate rice without loss of yield, 2t/ha per year since over 800 years without any fertilizers (Whitten *et al.*, 2013). Given the limited space of the island, with most fertile land in the central highlands, shifting cultivations with a fallow period in order to regenerate fertility would not have been possible on top of being less sustainable. The limited resources available in addition to the necessity of food to survive resulted in a sustainable farming system until new elements disrupted the century old balance.

With rising Malthusian tendencies, of native and foreign populations increasing pressure on limited land-based resources, the complex question of sustainable development arises. Martopo *et al.* (1995) recognized that Bali faced specific challenges, which need to be researched in order to maintain harmony and develop sustainably. The following features (Whitten *et al.*, 2013, p.107) facilitate the study of sustainable development in Bali through an agroecological lens:

- the island is a single political unit;
- it has established physical boundaries;
- it is relatively small (5780 square kilometers);
- it is culturally and historically distinct;
- it has strong human resources;
- Balinese are known for their independent thought;
- it is self-sufficient in food;
- it has no heavy industries;
- already ongoing sustainable development strategies;
- major industries based on foreign exchange;

These create tensions by pushing the islands' development in different directions. Even though it would be difficult to find anyone against sustainable development, actors involved fail to find a common ground. It is consequently necessary to identify a collective objective by consulting all actors. Obstacles in the pursuit of that goal also have to be diagnosed, in order to be addressed. Once that has been done, strategies can be researched and tested. Actors can then decide for themselves which strategy fits best their interests, as long as they are in the previously defined frame of development.

The success of those designed agricultural strategies will depend on the collaboration between actors and the political will. However, if the national and local government does not support the strategies, it will be extremely difficult to succeed. The implementation of strategies to increase agricultural productivity in the past decades, like “BIMAS” serve as an example. Even though top-down strategies and agricultural productivity revealed limitations (Gliessman, 2015; Lansing, 2006; Hansen, 1971), Indonesian government fails to rapidly adapt. Bottom-up approaches, social mobilization and peasantry movements show positive outcomes in the adoption of sustainable agricultural practices, and therefore need further research (Schiller *et al.*, 2020; Copeland, 2019; FAO, 2018 & 2014; Gliessman, 2016 & 2015).

Rapid urbanization in Bali led to several negative consequences. Traditional way of farming and living is challenged by mass tourism and overdevelopment and is therefore threatened to disappear. The endless factors involved in Bali’s (over)development give many opportunities to research sustainable development from different angles. Bali’s agricultural evolution is complex and alarming, but if food sovereignty is desired, farmers should have the right to define the food production system they desire and receiving adapted political support (Patel, 2009).

1.4. Gaps in the knowledge

The socio-economic and ecological benefits of adopting agroecology at farm level has been demonstrated through extensive research (Schiller *et al.*, 2020; FAO, 2018; Isgren & Ness, 2017; Mendez *et al.*, 2017; Gliessman, 2015; Altieri, 2015 & 1995). The transfer of knowledge is a grey area as many variables influence the uptake and application of innovative techniques. Some studies have explored the obstacles faced by actors involved in the transition, so these could be overcome. Yet, each socio-geo-political presents a specific set of characteristics, thus influencing the transfer of knowledge differently. In the last decade various challenges faced by farmers in South- (Schiller *et al.*, 2020; Copeland, 2019) and North America (Rodriguez *et al.*, 2009), Africa (FAO, 2018; Isgren & Ness, 2017), Europe (Bergez *et al.*, 2019) and Asia (Shiva, 2019; Lansing, 2006) have been researched. However, research on difficulties faced by small-scale farmers in the transition to agroecology in Indonesia, more specifically in Bali are non-existent or unpublished, at least to my knowledge.

1.5. Aim of the study

Consequently, the main goal of this research is to explore and identify important barriers and opportunities to a wider adoption of agroecology in central Bali, Indonesia.

1.6. Research question(s)

In order to promote sustainable development and maintain self-sufficiency of food production the following research question was developed:

What are the main barriers and opportunities for small-scale farmers to scale-up agroecology in central Bali?

A few underlying questions came out of the main one:

- What are some current economic, social and political challenges faced by Balinese small-scale farmers in the adoption of agroecology?
- What are the possible ways or methods for farmers to adopt agroecological practices?

2. Methods of research

2.1. Research approach

The theoretical strategy employed is fundamental as it outlines the way the research question is addressed, and the data collected. More importantly, it shapes the role of the researcher in the process. In the sphere of social sciences, and even more so in the transdisciplinary science of agroecology, there are three main research approaches: quantitative, qualitative and mixed methods.

The first research method is quantitative and highly structured, as the researcher has identified variables before the empirical collection (Creswell, 2014). It relies mostly on measurable phenomena, which are observed and confronted to initial hypotheses, which are confirmed or rejected (ibid). Testing objective theories by examining the relationship among the variables permits a law-like generalization of a phenomena. Statistically analysing the numbered data then allows one to predict a behaviour or action (ibid). This approach is very useful in agronomy for example, which studies the techniques to increase yield in food production (Gliessman, 2015). Using quantitative methods will allow us to predict the outcome of certain agricultural methods. This approach pinpoints a tendency as it simplifies a phenomenon, but it might neglect other influential factors, which are not quantifiable or have not yet been identified.

This is where the second qualitative approach comes into play. This research technique is more flexible and open to new influential factors, as researchers do not know exactly what they will find in advance. This is reflected in my research question not precisely knowing what the findings will show. This strategy seeks to explore and understand the meaning individuals or groups attribute to a social problem (Creswell, 2014). Along the process of data collection, often in the context of participants, questions emerge as the research takes shape. The interpretation of the collected information is not absolute and subjective to the researcher.

The third research approach, called mixed methods is self-explanatory as it resides in the middle of the continuum of the previously described procedures. It applies elements of both quantitative and qualitative approaches (Creswell, 2014).

The qualitative research approach was chosen given the sociopolitical nature of answers in understanding the obstacles in the transition to agroecology in Bali. In addition, the answer to the research question would be better represented in words than numbers. While the quantitative approach would have focused on the measurements of behavior (Symon & Cassel, 2012), the ethnographic approach focused on the underlying meaning in relation to behaviors. Even though the latter approach can be seen as biased by the subjective perspective of the researcher, adopting the former would have meant to leave out valuable, and rich insights of participants. A qualitative approach seemed the most adapted way in trying to understand the participants' perception and experiences. In the context of sustainable development, the reasons why certain methods in a specific context are implemented, or not, by practitioners are more valuable than statistical tendencies. Moreover, extensive quantitative evidence on the economic, social and environmental benefits of integrated farming methods exists (FAO, 2018 & 2014; Mier *et al.*, 2018). However, the delays in the process from theory to practice is yet to be better understood. Lastly, in order to apprehend the phenomena, personal views, feelings and experiences of respondents, a qualitative approach is the most effective way to gather the information.

2.2. Research paradigm

Although conventional farming has shown its limits and attractive alternatives have been demonstrated, the widespread adoption of agroecology/permaculture has not yet occurred (Gliessman, 2015 & 2016; Altieri, 1995 & 2015; Schiller *et al.*, 2020). Thus, it appears that rational positivism is not sufficient to address and convince farmers to adopt certain practices (Rodriguez *et al.*, 2009). A social constructivist approach was picked to understand the specific and complex views of individuals in regard to their farming activities. The latter investigates a phenomenon within its natural environment and interprets them in terms of the meaning participant's accord to them (Denzin & Lincoln, 1994). Open ended questions permit participants to freely describe the context they live in and the meanings they ascribe to them. Consequently, constructivism was chosen to understand barriers which actors are facing in the adoption of agroecological/permacultural farming techniques. Also, since I am foreign to the problematic from a practical point of view, the main focus was to carefully listen to the answers of the respondents involved. Then, instead of narrowing the meanings into strict and absolute categories or ideas, the goal was to perceive the complexity of farming in Bali. Although this approach does not give definite answers, it provides foundation for further research including historical and cultural aspects of farming in Bali. This process of understanding participants'

personal views and difficulties would not have been possible with a quantitative approach.

2.3. Data collection

From end of June to mid-September 2019, the opportunity of an internship with a non-governmental organization (NGO), Tri Hita Karana Bali Foundation (THK) in Bali allowed me to introduce and grasp the study area. THK is a non-profit organization that promotes sustainable development of the island through permacultural farming and waste management services. In addition to the design and implementation of agroecological production systems, it supports various communities and facilitates organic certifications. My role was to assist and participate in these activities on a daily basis, allowing to experience and observe Balinese farmers and actors of the food system while collecting information for this thesis. The whole process from internship, literature review confronted with practical observations to the design of my questionnaire until the writing of the final report is resumed in *Figure 2*.



Figure 2 - Resumed process of methods and data collection

2.3.1. Observations

In the beginning of the field study, except of the internship supervisor, future interviewees did not know about the study. Being part of the NGO's daily activities gave me a fair understanding of the practical challenges of sustainable farming in Bali. This first step allowed to compare theory and practice, as it is common to observe a gap between academic work and actual needs of practitioners (Feder *et al.*, 2004). Also, I developed a wider perspective of daily struggles faced by Balinese commercial and subsistence farmers. Being an intern for a well-known local NGO gave me the opportunity to avoid being seen as too intrusive yet giving some freedom and legitimacy to observe and ask questions. After initial observations for the first two weeks, the internship advisor introduced me as a researcher during an organic certification workshop, after which I presented myself and the intentions of my work. Among the approximately 25 farmers (only male), around five came to me expressing interest, sharing their experiences and background. I collected their contact information to organize

logistics and visit their farms in the coming weeks. All farmers presented in the workshop were already involved in organic agriculture, or at least interested in transitioning to more sustainable farming methods. Nevertheless, the language barrier was an important factor in the sampling of participants. I quickly assessed who would be able to reply to my questions before organizing meetings.

2.3.2. Focus group

Focus groups can be defined as a “group discussion in which persons from the target group discuss different aspects of a topic” (Ivanoff & Hultberg, 2006, p.125).

This way of collecting data is time efficient as participants share their opinions in front of each other and tend to structure, refine and discuss their respective perspectives. As a debate might occur, different arguments and experiences are shared. The researcher listens and guides the debate according to the research topic. The perceptions and arguments are organically presented, and the data collected is therefore already relatively clear and synthesized, facilitating the researchers work. The main disadvantage of a focus group is that participants might withhold some more sensitive information that they potentially would have shared in private interview. Also, depending on individual’s oratory skills and personality they might agree with different opinions to avoid confrontation.

In regard to the study, the focus group took place on one organic farm we intervened on with the NGO. The aim was to understand their perspectives and challenges as Balinese small-scale farmers. None of the two interviewed spoke English, so a third was asked for translation. Recording the focus group permitted to completely focus on the discussion, deepening narratives with further questions. It became obvious however, that some of my questions like what farming meant to them, were too abstract to their everyday life. The information collected from the focus group was consequently limited in addition to the fact that much details were lost in translation. Despite having the intention to conduct both focus groups and semi-structures interviews, I realized the inefficiency to collect pertinent data from this method in my context.

2.3.3. Interviews

From the personal information obtained, I visited the respective farms around the island. It would sometimes take me up to two hours to drive to a farm in the highlands of Bali, seen on *Figure 4*. It was also informed upon request, that it was customary to bring half a kilo of coffee and a kilo of sugar per person interviewed for their time. However, this was not negotiated with participants and was given after the interviews to avoid any influence on their narratives. In total, seven semi-

structured interviews were conducted in addition to one focus group with two farmers and one translator.

In order to understand specific difficulties hindering Balinese farmers to implement more sustainable methods, the main data collection method was in depth qualitative face to face semi-structured interviews. This method permits to obtain personal and detailed insights which emerged from interviewees' life experiences and narratives. The latter would not have been possible with closed questions. The open-ended questions allow interviewees to answer in the way they seem fit and to elaborate on aspects they felt relevant and comfortable sharing (Rubin & Rubin, 2012). Most importantly, it allows interviewees to raise issues the researcher has not perceived (*ibid*). Also, a well thought questionnaire is when the interviewee independently replies without the researcher having to explicitly ask all questions. Sometimes, points were addressed before the questions were asked. The flexibility of the semi-structured interview allows to skip certain questions seeming less relevant at the moment or to discuss further on certain points made (*ibid*).

In comparison to unstructured interviews, in which questions are formulated as the interview unfolds, the semi-structured interview frames the interview in the direction relevant to the research (Rubin & Rubin, 2012). The interview guide was developed for small-scale farmers and comprised a set of fourteen questions divided into six themes (Appendix A) guiding the interview. It is relevant to note that a slightly different questionnaire would have been developed depending on the actor interviewed. Unfortunately, none of the governmental/political actors that I contacted were available. Even though including a political actor from the Ministry of agriculture would have enriched the analysis, it is relevant to mention that two of the interviewed actors occupied governmental functions during their career. Also, whenever the interviewee would raise a potentially relevant aspect to the research, additional questions were asked. The aim was to have a smooth and fluid discussion, which would feel comfortable to the interviewee, but gathering as much information as possible to be refined and analyzed afterwards.

Ethical aspects were considered throughout the process of the study to avoid moral issues and malpresentations of the participants narratives. In accordance with the Helsinki declaration of ethics, principles were followed to stay transparent in regard to the purpose of the study and use of the data collected. Since personal information and sensitive statements like critics of governmental functioning was gathered, participants' identity was kept anonymous. Lastly, before starting any interview, permission to record was requested so I could fully focus on the interaction and have access to the complete discussion later on. Of course, they could change their mind at any time, stop the interview or request further clarifications.

2.3.4. Documents

THK provided some documents as the organization has conducted previous research and projects in collaboration with other actors involved in the sustainable development of Bali. On request and during the internship, data was collected which gave further insight on not only the activities of the NGO, but also the challenges faced from food system actors, desiring to implement a sustainable food production system on their land, and in their businesses (restaurants, resorts, “Eco-Stay” accommodations, Yoga center).

In comparison to the interviews, the use of secondary data such as records and survey results from organizations helped me as the synthesizing and structuring of information is preliminary performed, and this information can be accessed and consulted at my convenient time. The downside is that there is risk for such information to be incomplete or inaccurate in regard to the research (Creswell, 2014).

2.4. Sampling strategy

In order to perform the study, a focus on practitioners was adopted consciously as they are the most plausible to adopt agroecological practices, besides being available and responsive to my requests. *Table 1* shows the various ways information was accumulated. As aforementioned face to face interviews were conducted to understand and answer the research question. In addition, information from other sources were collected to compare different perspectives. During my stay and internship, I managed to speak, observe and participate in different discussions and activities, which further fortified my understanding, thus the findings of the research.

Thus, previous to my arrival, a non-random convenience sampling strategy was chosen, implying a purposefully selection of participants, ideally with a broad spectrum of backgrounds and experiences (Trochim & Donnelly, 2005). More precisely, a purposive sampling method was chosen, as this strategy allowed me to use judgement to pick the sample according to certain characteristics (Creswell, 2014). The opportunity of the internship permitted me to use my supervisors and the NGO’s network to first observe and meet, before selecting participants according to the two main criteria shortly mentioned in the observation section. Firstly, they needed to be involved in the transition and implementation of sustainable farming methods; and secondly, their English proficiency.

Table 1 – Methods used in collecting information

Type of data gathered	Details
Semi-structured interviews Focus group	<ul style="list-style-type: none"> • 7 participants • 2 participants
Observations of food production systems visited	<ul style="list-style-type: none"> • Restaurants • Farms • Rice fields • Subak systems • Eco-Agro tourism • Resorts
Literature review & documents	<ul style="list-style-type: none"> • Scientific literature • Governmental regulations • Organizations documents (THK, NI) • Newspapers
Workshops & Presentations	<ul style="list-style-type: none"> • Tri Hita Karana Bali • Organic certification
Meetings to design, implement and supervise food production systems	<ul style="list-style-type: none"> • Resort • Yoga Center • 2 Restaurants

2.5. Analysis of information

The method of choice to analyze the interviews was “applied thematic analysis” (Guest *et al.*, 2012). Given the substantial amount of collected data, it was essential to firstly explore and identify common patterns (Guest *et al.*, 2012). Once common themes were spotted it became easier to refine the data further.

Albeit some argue that quantifying qualitative data is a fundamental violation of the qualitative approach (Suddaby, 2006), others think quantifying qualitative data actually gives more validity to findings by demonstrating positivist deductive rigor (Silverman, 2000).

One qualitative method of analysis was to compare and contrast the statements of participants and what could explain those differences. Participants were divided

in three categories according to the sector of activity of their main income. It is interesting to note that some had different opinions in regard to the use of agrochemicals or the government's role. After transcribing the interviews, common themes were clustered into categories. Then it was relevant to observe associations between them. In the context of this research, it was logical to observe the dependency of one phenomenon to another, like the increase of tourism with access to land as land tenure evolves from agricultural to tourism and real estate. Then leading to rapid decrease of water reservoirs, which causes tensions with farmers as irrigation is affected and yield reduced. It is therefore important to mention one theme along with their co-occurrence to another. In order to analyze relationships of barriers to agroecological transition it is essential to explore the frequency at which pairs of characteristics or events appear (Guest *et al.*, 2012). Once deductive links have been observed, it was pertinent to compare similar tendencies in the different contexts of the scientific literature available (Schiller *et al.*, 2020). This last step permitted the triangulation of different sources of information (Creswell, 2014). In this case, data collected from interviews representing the Balinese farmers perception, with barriers faced by farmers from different countries from the literature, discussion with actors from the Balinese food system and unpublished documents. This in turn gives significance and validity to the findings. Although particularity rather than generality is the rule of solid qualitative research, some generalization can be useful in the conclusion (*ibid*). Thus, concluding with some additions to a broader theory seems favorable in order to pursue research or, in this case, recommendations. Finally, personal biases are mentioned in the limitation section of the study.

2.6. Participant's description

Among the nine participants, five were considered small-scale farmers who were generating their main income from farming activities (*Table 1*). The mountainous landscape of central Bali makes it difficult to cultivate large areas at once. Farmers therefore operate one or multiple smaller (>0.5ha) surfaces. Moreover, among those five, three had a tertiary degree, respectively in civil engineering (Farmer 1), tourism and hospitality (Farmer 2), and information systems (Farmer 3). All three were successfully established in their respective careers and consciously returned to farming due to personal values and preferences. These three also were part of organic certification process to increase competitiveness and profit margins. The other two small-scale farmers, one female (Farmer 5) and one male (Farmer 4), started farming after finishing high-, respectively elementary school. Farmer 4, born in 1955, was still farming at the

time of the interview, making an income twice a year from selling fattened cows and pigs. Each of these five farmers operated less than 5 hectares in total and applied some principles of permaculture and agroecology, relying less on agrochemical inputs while increasing ecological synergies. The two consultants and tourism actors also applied those principles on their land or were at least familiar with those methods. Nevertheless, they did not generate their main income from it.

Table 2 - Resumed details of participants

Participants category	Participants details
Small-scale farmers	<ul style="list-style-type: none"> • Farmer 1 (M, 1987), Civil engineering • Farmer 2 (M, 1981), Hospitality • Farmer 3 (M, 1970), IT • Farmer 4 (M, 1955), Elementary • Farmer 5 (F, 1985), High school
Consultants	<ul style="list-style-type: none"> • Consultant 1 (M, 1973), BSc • Consultant 2 (M, 1946), unfinished BSc
Actors from tourism industry	<ul style="list-style-type: none"> • Tourism actor 1 (F, 1983) Bsc, Sanur Resort • Tourism actor 2 (M, 1955), unfinished BSc, Eco-tourism

Legend: (biological sex, year of birth); highest education obtained

The four not generating their main income from farming were included to enrich the perspective on the problematic. Gathering the perspective of various actors involved in the transition of agroecology allowed to triangulate the information, thus strengthening the findings. Two participants were consultants, one of which was retired (Consultant 2) but still supervising the management of his appropriate technology consultancy company. The other consultant was still extremely active in designing and implementing agroecological farming systems for privates. He also implemented sewage water systems with plants among many other social projects like beekeeping. The two tourism actors were involved in agro-eco-tourism and applied or intended to apply sustainable farming methods. The second tourism actor was the only non-Indonesian, as he was born in Tasmania and lived in Queensland, Australia before moving to Bali to establish

his eco-tourism business. He offered a Balinese experience with traditional accommodation and food coming from their own production system, which was designed by Consultant 1.

Lastly, only two women were represented among the nine. Nevertheless, they presented distinct characteristics as Tourism actor 1 went through third level education and worked for WWF, while Farmer 5 started farming after finishing high school. Furthermore, the former's family owned a resort which was managed by her brother. I met her during an initial meeting to implement a food production system at their resort to partially supply their kitchen.

Most of them were planting a mix of the following: indigenous rice varieties (*Oryza sativa*); some horticultural crops like mangosteen (*Garcinia mangostana*), jackfruit (*Artocarpus heterophyllus*), wild and hybrid varieties of banana (*Musa acuminata* & *Musa balbisiana*), durian (*Durio zibethinus*), salak (*Salacca zalacca*), eggplant (*Solanum melongena*) and patchouli (*Pogostemon cablin*) for essential oils to name a few.



Figure 3 - Interview locations (Freeworldmaps, 2020)

On Figure 3 are marked the locations of the focus group and interviews. The furthest north location includes the focus group of Farmer 4 & 5, but also the individual interview of Farmer 1.

3. Presentation of Findings

This section addresses the two sub-questions presented with the main research question. First, the identified barriers faced by small-scale Balinese farmers in the transition to agroecology and the adoption of more sustainable practices. Second, the potential opportunities to overcome these obstacles, in accordance with agroecology. And lastly, some trade-offs and risks in the adoption of agroecological practices.

3.1. Identified obstacles to agroecology

According to section 2.5, raw answers were clustered in three key themes hindering the development of agroecology in Bali. These were 1) a lack of attractiveness in the agricultural sector; 2) an overall lack of knowledge and awareness of agroecology among all actors of the food system, but particularly producers, and decision makers, which is linked to 3) lack of political guidance.

3.1.1. Low attractiveness of agriculture

Four interviewees (the two consultants, tourism actors and Farmer 3) mentioned that farmers were “*leaving the fields*” (Consultant 2), because of various mechanisms resumed in the flow diagram below and explained in the following paragraphs. This section contains the following four subthemes in bold italicized texts which contribute to the loss of attractiveness in Balinese farming.

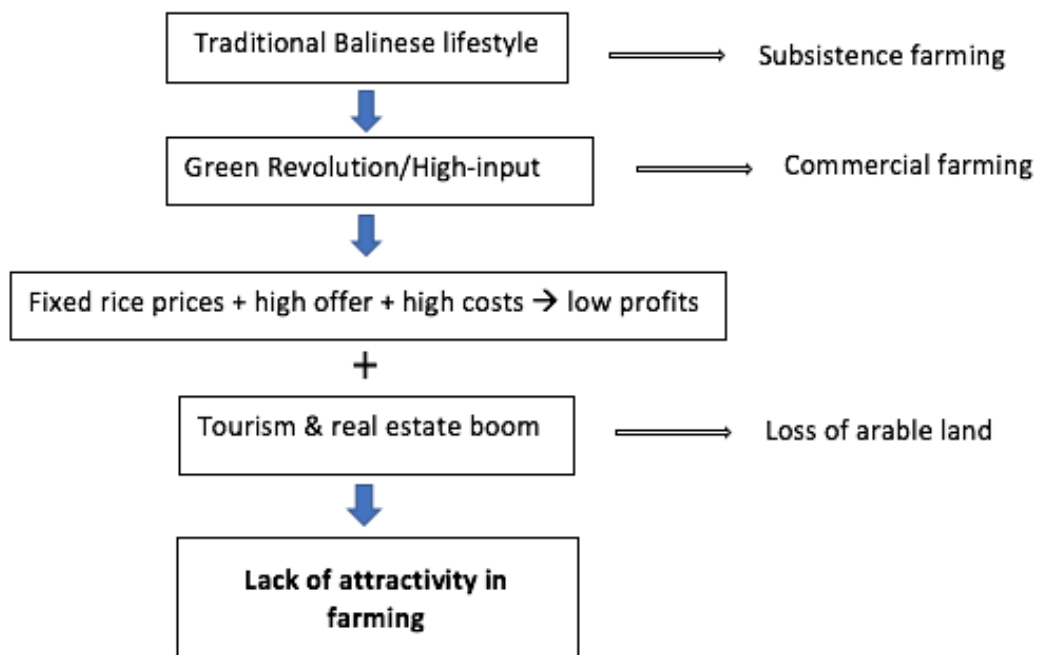


Figure 4 - Flow diagram for lack of attractiveness in Balinese agriculture

3.1.1a. The change of mindset: from subsistence to commercial

Consultant 1 founded the NGO THK, based on the Balinese philosophy of the same name. “Tri Hita Karana” means three pillars for prosperity: harmony among people, with nature, and with the divine. Bali’s rich and diverse religious history has a large influence on all dimensions of Balinese life, as rituals, ceremonies and offerings are practiced daily. In the following quotation, Consultant 1 described his upbringing in a small village beneath Ubud and how isolation surrounded by rich biodiversity imposed a very sustainable way of living as everything consumed had to be produced locally:

“Growing up in the village, where it’s so abundant. So much diversity. And really proud of it because there were no connection from... there were no proper road from one village to another. Everything we grow within the small village. So there was no need, no electricity, no transportation. But everything we do is totally local. It was one of the great example of sustainability. Bali was known for that.”

Although both Consultants and Farmer 2 described a “harsh” (Consultant 2) and modest childhood, they recalled the necessity of local ecological knowledge about edible plants and their natural habitat, as their livelihood depended on it. By default, self-reliance was instinctive to accommodate their primary needs. Farming then transitioned from subsistence to commercial, as yields did not only

serve to eat, but increasingly were grown to be sold. Consultant 1 observed a change of mindset among farmers, which would later lead to an increasing dissatisfaction:

“Before Green Revolution there was no Industrialism, there was no mind of selling. It was more like, for yourself. And any excess production from the farm, you trade it. It was as a system that... it was a really good system.”

Furthermore, Consultant 2 shared his upbringing in Bali and the traditional production system. Born in Bali in 1946, Consultant 2 studied abroad before returning and working as a low-tech consultant in rural development. He described his experience of rice cultures before the GR:

“We were just planting for one year. At the beginning of the rainy season, we were working in our rice fields and then when the dry season come, we harvest. Once a year. Therefore occasionally we go out of rice and we go hungry. That's the system that we had. We don't use fertilizer, we don't use insecticide. We don't use any of the modern things.”

Subsistence farming, described by both consultants and practiced for centuries, firstly seeks to satisfy the primary caloric needs of the farmers' household and community. Moreover, the production system was by default designed within ecological limits and inherently sought to use environmental services and synergies. This allowed fertility to be maintained over generations as artificial inputs were not available; thus, the system being sustainable. Nevertheless, both consultants' narratives described limited annual harvests along with occasional food shortages, which implied the need to increase food security, thus agricultural productivity. Consultant 2 clearly mentioned the need to maximize output with the same amount of land as families grow in numbers. Chemical assistance was beneficial to intensify production.

3.1.1b. The chemical trap, leading to little profit

Despite increasing productivity, it was observed by three participants (both consultants and Tourism actor 2) that the adoption of new technologies lead to higher costs and lower profits.

Despite being sustainable, the productivity of traditional farming methods was not sufficient to match the growing demand for food. So, in order to increase food security and further stimulate economic development, it was rational to adopt promising agricultural technologies, which would boost agricultural productivity.

It was explained by Consultant 2 that there was an initial increase of rice yield, but then more artificial inputs were required in order to maintain high yield:

“We get this hybrid rice, people start growing it and then “boom”, it’s growing lots. But then after a while it’s getting less and less and less. So we have to feed it with fertilizers. And that’s the beginning of... If it’s to save you, ok if you can afford the fertilizer, but if you don’t. Then it’s a curse. “

The initial increase of yield is alluring but the following increased requirements of external input are a “curse” (Consultant 2) if the farmer cannot afford the fertilizers. The lock in situation is explicit and leaves little maneuver to small-scale farmers in regard to their option of farming practices. Moreover, Consultant 1 then explained the specific situation in regard to rice cultivation:

“The Government control the price. If you grow the chemical rice. Farmers grow rice [because] it’s very convenient to grow rice because there’s always demand for it. But they actually make very small money from it [...]. They are addictive to chemicals. They are addictive [addicted] now. They can’t stop. Hard one, because it’s a devil circle.”

Gliessman’s agrochemical treadmill concept is explicit in these two narratives. Once small-scale farmers adopt hybrid rice varieties, they are financially committed and locked in, as initial investments or credits need to be covered. Besides the financial obligation, farmers become dependent as the offspring of those varieties will not exhibit the desired hybrid vigor (heterosis). Consequently, every growing season farmers need to reinvest in hybrid seeds along with higher amounts of fertilizers and pesticides as was mentioned by the consultants, which become more expensive. Despite the short-term increases in yield, little profit is left once farmers have covered their costs and repaid what they owed.

On a surface level analysis, it is evident that subsidies are supportive, but in combination with the “treadmill” concept of sterile seeds along with agrochemicals, it actually does not emancipate them. Facilitating access to a product which is intended to be bought is not altruism, it is just marketing. The fact that many farmers would not be able to afford those hybrid varieties and chemicals independently, but are given credits in order to enable them to do so, is a poisonous gift. Both consultants confirmed the perversity of this system and explained that as it is initially subsidized, farmers perceive it as an opportunity. However, once they owe parts of their future harvest to a higher authority, they sometimes realize what an initially alluring, but ultimately absurd, system they contributed to.

Additionally, as rice paddies are all adjacent and cross contamination occurs, each farmer is dependent on the neighbor's practices, thus losing power over choice of applied methods. Growing frustration pushed farmers to abandon their activity and seek another way to make a living as described by the two consultants. One of the consultant explained that years of low profit made farmers skeptical towards any innovative technique:

“Because of the rice (price) not increase, (it is) not making much money, so they're leaving the rice field... To work as a driver, or on construction site[s] or become a teacher. Anything but farming. So therefore they don't really look at farming as main income. But, there's a challenge. Whenever you have a good idea about more sustainable farming, they refuse to adopt that because now they are not looking at farming as a main income.”

Consultant 1 noted farmers' skepticism towards the uptake of new technologies. Consultant 2 however, explained that once farming methods have shown financial gain, adoption and application of those methods are dynamic.

3.1.1c. Decreasing access to land-based resources

It was mentioned by the consultants, Farmers 2 & 3 and Tourism actor 2 that younger generations were less interested in farming for various reasons. Witnessing their parent's meagre economic compensation in exchange for hard field work might not be appealing, thus hinting to study and work in other sectors. A young farmer (Farmer 2), ca. 40 years old, grew up in a small village in the north of Bali named Suwug. His father grew rice and other crops on their land but expressed the difficulty of making a decent income from it, especially because rising water shortages increased vulnerability to potential crop failure. Farmer 2 evoked helping him after school as he encouraged him to follow a different path:

“Because [...] as my father said, too many problems in the farming system [...]. So to get a better life, it's too hard to become a farmer. So they always said, maybe you can be a cop, police or something.”

After obtaining a tertiary degree in tourism, successfully working in hospitality and as a real estate consultant for a few years, Farmer 2 reflected on his purpose and reassessed his professional choices as such:

“I found myself going too far [...], so I wanted to go back to reality.”

Although he seized the opportunity for a “*better life*” (Farmer 2) in the city, transitioning from agriculture to hospitality and real estate, he ended up feeling unfulfilled in his activity and returned to commercial farming, as it was more meaningful to him.

3.1.1d. Spatial competition, a farmers’ dilemma

Tourism actor 1 was born in Sanur, which is a coastal stretch in southeast Bali. Her family owned a resort that her brother was managing. She consequently grew up in that industry, surrounded by “*expats*” (Tourism actor 1). She mentioned the dilemma small-scale farmers face in the context of mass tourism and high foreign investments. With a growing demand for accommodation, land owners have the option to sell their land and almost instantly increase their quality of life. When asked what the main challenges faced by Balinese farmers are, she said:

“They can make more money by selling/renting their land or villas, instead of working on the land. [...] That’s pity. Because we need food and ideally we can; Bali island can sustain itself. And not get [...] outside, but if we keep building, building, that’s going to be hard.”

Balinese tourism which caused a real estate boom competes with agriculture for land. Despite agriculture being deeply rooted into Balinese culture, many end up selling their land to real estate investors. According to Consultant 1 at least 1000 ha of arable land is lost every year to tourism-related projects in Bali.

3.1.2. Lack of knowledge

The lack of knowledge has been explicitly or implicitly mentioned by all interviewees or noted during observations in different aspects of the food system. A knowledge gap among producers was noted and observed by seven participants (Consultant 1 & 2, Farmer 1, 2, 4, 5 and Tourism actor 2). Moreover, a lack of awareness among political actors was mentioned by four participants (Consultant 1 & 2, Farmer 1 and Tourism actor 2).

Despite all participants having acknowledged the negative consequences of high-input-dependent farming methods, Farmer 4 & 5 seemed to have a positive perception of it. When asked what they thought about governmental subsidies during the only focus group of two, (which was translated by a third), they said:

“Good yeah. They think good. Helping for the poor men. And also, the farmer like it’s not hard to get access to fertilizers.”

Even though the answer does not directly inform on their opinion in regard to the consequences of the GR, it clearly demonstrates unfamiliarity with the environmental and social impacts of being trapped in a system with high agrochemical inputs. One positive opinion in regard to subsidized fertilizers was obviously not sufficient to draw any conclusion, so a few follow-up questions allowed further understanding. When asked jointly with Farmer 5, the only female farmer interviewed, about their concerns about the sustainability of farming, the answer was:

“They don’t know about the sustainability.”

Even though this question was not neutral and could have hinted at a type of expected answer, the reply was clear. It showed a lack of environmental consciousness or concern, which results in the same outcome: neglect of the ecological consequences of potentially negative agricultural practices. It could be argued that their ecological knowledge was inherent or unconscious, but further quotations in different context suggest a gap of knowledge or consideration.

Also, in Indonesian language “*fertilizers*” are referred to as “*medicine*”, which demonstrates how deeply rooted the use of them is perceived as harmless, even reasonable (Consultant 1). Consequently, it is evident that many Balinese farmers are not educated on the risks of relying solely on agrochemicals and the long-term socio-environmental and economic repercussions of high inputs of synthetic nitrogen fertilizers and pesticides.

According to Farmer 1, the main barrier to wider adoption of more “*organic*” farming methods is due to a lack of education. He explained that conventional farming methods, inherited from the GR are still in many Indonesians’ minds, thus requiring more time to change:

“In Indonesia, it is difficult to change the mindset to be like organic. [...] Maybe like 30 years ago it was the Green Revolution and that’s why they... still in that mindset. [...] Because why do they use the chemical? The question. I tell you. Because all the people, all the farmer in Indonesia, low education. Very important. Low education!”

This is the core challenge of the problematic, accelerating the transfer and application of agroecological knowledge. Farmer 1 pointed out and confirmed what was also observed by Consultants and Farmer 2: the necessity for farmers to make their activity financially viable through more sustainable farming techniques. Until “*proof*” (Consultant 2) of economic gain is not observed, they will stick to conventional methods.

3.1.2a. Diversity in production

Lack of diversity in Balinese agriculture was mentioned by five interviewees (Consultant 1 & 2, Tourism actor 1 & 2, Farmer 2). Consultant 1, who was born in 1973 and promotes integrated farming techniques like using duck on rice fields to manage pests and cycle nutrients, formulated it clearly:

“They always grow rice, they get nothing from it, but they keep growing rice because they know they can sell it.”

Moreover, it was generalized by Tourism actor 2 that monocultures, whether it be rice (Consultant 1), timber (Tourism actor 2) or tomatoes (Consultant 2), make farmers more vulnerable to crop failures and less resilient to pests, market changes or extreme weather events. This was even more so the case in monocultures of hybrid varieties, according to consultants and one of the tourism actor. Furthermore, it was expressed by at least three participants that little diversity created a large supply, which reduced the market price of the monocultured crop.

It was also recognized that the difficulty was to provide a consistent supply of various crops from sustainable production systems. Therefore, Farmer 2 said:

“For the sustainable [...]. Not in one cropping. [...] So we must make good (diversified) designs for the planting.”

Farmer 2 explained that not only production systems needed to be more diversified, but also timing of harvests among farmers, so supply could be made accordingly to market demand. Tourism actor 1 identified the competitive edge of conventional farming systems as being the stable supply compared to agroecological farming systems:

“I think that’s the problem with many organic agricultures. The supply [...], because some pest or some natural condition, then we have no more produce. Not consistently, and then you have to find another place and that’s usually maybe not organic anymore.”

3.1.2b. Market access and marketing skills

Except for Farmer 4 & 5, who had no opinion in regard to farmers’ access to markets, the other interviewees recognized the unequal distribution of profits due to the presence of too many “brokers” (Farmer 1) and “middlemen” (Consultant 1 & 2, Tourism actor 1 & 2), who largely “control” (Farmer 1) the prices.

“There are middlemen of course. Kind of occupying that space. And it’s really, the farmers really got very very small money. And I think most of the money is for the middleman.”

The presence of middleman suggests the market mechanisms that lead to the corporate domination of the food system. Accordingly, the lack of producers’ control and influence over the desired food system which will be developed in the discussion section. Furthermore, in regard to product distribution, two participants (Consultant 1, Farmer 1) clearly mentioned the difficulty of marketing their products as it was a whole different skill set than growing food. The difficulty lies in justifying the added value from organic products over conventional, so they can remain economically competitive:

“I bring my products from the farm and I want to get like, at least fifteen thousand (IDR) a kilo for my veggies. But this guy selling it like, five thousand, seven thousand (IDR per kg) and I will be broken. I [...] compete to them. [...] But how do I tell that mine is the real one? How do I convince buyers that mine is the real one without [...], kind of hurting them, you know?”

Furthermore, even when consumers believe they are buying organic products, it does not necessarily mean they are contributing to sustainable Balinese agriculture. After acknowledging the difficulty in justifying the price difference of agroecological products compared to conventional products, Consultant 1 deepened the problematic by mentioning the conscious lack of transparency of some restaurants:

“The reality is that, because many restaurant[s] are claiming they’re organic, but they are not. Of course when you come here, you know nothing and you go to organic restaurant, and all in your mind thinking, “I support, I eat at organic restaurant, and organic restaurant support the organic farmers.” That’s in your mind.”

It is understandably complex to grasp slight differences between organic, local, sustainable, and ethical ways of farming, not to mention agroecological. Furthermore, it can be questioned: what is better, organic from a distant region or conventional but local? Life cycle assessments can give surprising results. Consultant 1’s experience shows the difficulty of competing with cheaper conventional products, where consumers are unfamiliar with manifold farming conditions. Moreover, some vendors and middlemen benefit from this vagueness

as they will brand their business and products as sustainable, organic, etc., tricking customers into believing they are supporting an ethical enterprise.

As tourism increases food consumption, it can drive or hinder towards agroecology, depending on consumers' choices and socio-environmental awareness. Yet, even with good intentions, the lack of transparency and access to quality information makes the choice arduous. Further education of actors in the food chain is therefore necessary. Nonetheless, a slowly growing environmental consciousness and interest is observed. In order to further assist consumers and vendors in making more educated choices, the decision makers also have a role to play.

3.1.2c. Lack of ecological principles in policy design

Five interviewees (Consultant 1 & 2, Farmer 1, Tourism actor 1 & 2) mentioned that Indonesian government was still supporting the use of agrochemicals, more specifically the application of *“RoundUp for anything”* (Consultant 1):

“I think they’re still supporting the fertilizer... Giving out free fertilizer for farmers. That’s how they’re helping the farmers. Fertilizers and pesticides.”

The subsidized farming system could stimulate and promote more sustainable practices, but instead it still promotes unsustainable ones. This shows a lack or neglect of ecological knowledge among political actors. Even when farmers consider ecological limits and grow food in harmony with their agroecosystem, contributing to unevaluable socio-environmental benefits, governmental policies counter acts by supporting unsustainable agricultural practices.

3.1.3. Lack of political guidance

When asked about the role of the Ministry of Agriculture in Indonesia, none of the nine interviewees were able to give a straightforward answer as most had no clear idea. It is interesting to note that two participants (Farmer 1, Tourism actor 1) laughed at the question, as if the role of the institution could not be taken seriously.

Farmer 1’s insight was the most valuable as he worked for the Ministry of Agriculture after obtaining his tertiary degree in agriculture. Here is a passage of the interview with him:

“I’m not sure what they do (reflexive look). Before I work for the Government also [...] but no more money (laughs). So I resigned from the Government. And they just... many corruption. Maybe [...]. They don’t spend money to the people. So, I don’t want to work with the Government.”

It was surprising that even someone who worked for the Ministry of Agriculture was incapable of explaining the moral objective or at least some daily activities. Consultant 1 also shared his negative experience with the Ministry of Agriculture. He was trying to expand a distribution network to Singapore in order to increase and stabilize income for local indigenous rice growers but failed due to administrative inefficiency. He explained in a state of frustration that the rice rotted in a warehouse at the airport:

“I think you understand because it’s a very corrupt country. I went to the agriculture department, and... I could not get this, [...] recommendation letter from [the Ministry]. It’s still at the [airport warehouse], since 2015!”

By default, many farmers do not expect anything from governmental actors. Their role and objective is unclear and this therefore hinders effective collaboration, which in turn hinders any development.

Besides the unclear political involvement and agenda, both Consultants and Farmer 1 said governmental agricultural actors “never” (Farmer 1) visit fields and seem unconcerned about small-scale farmer’s challenges.

In contrast, Farmer 2 & 3, who were both part of a peasantry association, said the government was “support”(-ive) (Farmer 2) in regards to farmers. Moreover, Farmer 2 mentioned the latest incentive of the 10th Governor of Bali, Wayan Koster:

“The government is positive about that. So, as you know, the new governor. His name is Koster. So they make a new rule. All of the restaurant industry in Bali [...] must use the local product. Like fruit, vegetable or something. But sometime import is ok, but [...] use the local product.”

This positive appreciation of the government was contrasting, showing political concern with a proactive response to the acknowledged problem of Bali’s food self-sufficiency. If this regulation is ratified and introduced, it would, along with ecological farming principles, contribute to the local development of food production.

However, Consultant 2 also noted that a lot of farmers still relied on agrochemical inputs and would therefore not be able to produce as much without it. Thus, it seems farmers and political actors are responsible for high application

of artificial input and lack the awareness of long-term consequences of those. Farmer 1 observed the combination of factors which allowed this, as he noted the lack of education of farmers permits multinationals to push their agenda:

“Many company... Company fertility, they (work) together with the Government, so it’s easy for them to (implement their innovations)... So [...], when Europa, Western come to the people, it’s very easy [...]. Because they don’t know anything. Just follower. And also the media [...] make them look very bad. And also, we cannot stop that. The system, cannot [...]. The people [...]. What we do, can just try to tell the farmer. Try to educate them [...]. Talk to them. Agriculture. Sustainable. Anything (is) better.”

Here, Farmer 1 made explicit the lack of education among farmers and unawareness or conscious disregard of political actors about socio-ecological consequences of high reliance on external synthetic inputs. It could also mean that political actors use agricultural policies as means to economic development, seizing the opportunity to collaborate with multinational agrifood companies. This latter possibility was noted by Consultant 1, as he mentioned that political actors work within five-year mandates requiring results in that time frame.

Lastly, three interviewees (Farmer 1, Consultant 1, Tourism actor 2) explicitly mentioned corruption in the political sphere, which implies a lack of trust in governmental actors and their ability to successfully guide and supervise national or regional affairs. The inefficient governmental administration was a clear hurdle to sustainable development in any way.

3.2. Opportunities for agroecology

The second part of the research question addressed potential opportunities for agroecology and the further sustainable development of agriculture. Three positive tendencies contributing to the transition to agroecology were identified: 1) the growing awareness about the necessity to adopt sustainable farming methods; 2) the advantageous access to markets in Bali and 3) the growing web of networks.

3.2.1. Growing awareness countering the loss of traditional knowledge

There were four interviewees (Farmer 1 & 3, Consultant 1, Tourism actor 1) who used negative vocabulary like *“dangerous”* (Farmer 1), *“really bad”* (Consultant 1), *“move away from”* (Tourism actor 1), *“reject”* (Farmer 3), when

asked what their opinion was in regard to the GR and the heavy use of agrochemicals. This observation however has limited significance as all of them were educated on the topic as they were part of a permaculture network. Yet, even among them, some were not convinced. Farmer 4, having experienced the GR, had a positive opinion towards subsidized fertilizers as aforementioned in section 3.1.2.

Despite being “*slow*” (Consultant 1) there is growing awareness about the social, environmental and health aspects of sustainable and organic food production systems according to five interviewees. This positive trend increases probability for Balinese to adopt more agroecological practices, which is also confirmed by Consultant 1’s final thoughts on the future development of Balinese agriculture, as he mentioned:

“More and more people requesting me to train different farmers in different area in Bali.”

Not only did most recognize the necessity to adopt alternative methods of agriculture, but five participants (Farmer 1 & 2, Consultant 1 & 2, Tourism actor 1) used powerful language to the question of what farming meant to them: “*that’s our whole life*” (Consultant 2); “*that’s part of your life*” (Consultant 1); “*farming is our culture*” (Farmer 2). The strong farming culture, connection to the land and proximity to farm activities are strong contributors to scaling up sustainable farming methods.

The deepest justification for farming was Farmer 1’s narrative. As he described his life changing experience of surviving the Tsunami in Aceh in 2004, he witnessed the aftermath of the tragedy as “*people*” (Farmer 1), “*horses*” died and homes were “*destroyed*”. He compared the land as “*sandy*”, “*just like desert*” and that he felt an obligation “*to do something to protect the land*” as he made a “*promise to God*”. In parallel, both consultants also participated in the recovery of Aceh, respectively in their field of expertise through permaculture and appropriate technology implementation. Consultant 1 met Farmer 1 during a permaculture course and they have continued spreading sustainable farming methods since, as it became a life’s purpose to restore the land and share regenerative farming methods in Indonesia, Bali and wherever needed.

Except for Farmer 4 & 5 due to language barrier, all understood the importance of farming. The multidimensional aspect of farming was explicitly recognized by Tourism actor 1. When asked what the agriculture meant to her, she replied:

“It’s a basic need of everybody. And I think it has the potential to reach, to disseminate the importance of ecology, nature and sustainability through food. Yeah I think that’s why I was interested in that aspect of sustainability [...] through agriculture or food.”

Understanding the intertwined problematic and this solution is the core approach to agroecology. Acknowledging that it is fundamental to address agriculture from different angles and include social, economic and ecological principles to address the negative externalities caused by previous yield-oriented agriculture.

3.2.2. Access to markets

Despite the difficulties encountered in the marketing process, the Balinese tourism industry offers exceptional access to markets. Overall, demand and distribution to markets was not considered a problem (Farmer 1 & 2, Consultant 2, Tourism actor 1 & 2) and even easier compared to Java or Sumatra (Farmer 1), due to higher tourism and softer regulations in Bali.

Moreover, the organic certification scheme that I participated in reinforces the positive tendency by marketing the added value from more agroecologically grown products, increasing competitiveness on regional, national and international level.

Farmer 2 was confident in the access to the market to distribute his products, as he stated:

“I work for the tourists before, so it’s easy to sell. So sometime [...] we, I come to the farmer market in Ubud, Sanur, Canggu. And then we have big connection with all hotel, restaurant... And we have good communication with all the other organic farmers.”

The relatively small island with dense populations gives plenty of opportunities to satisfy the large demand on various markets. Furthermore, the strong agriculture and farming community of Bali, solidifies and facilitates the linkage between actors within the landscape of food, or foodscape. Tourism actor 1 further mentioned that innovative marketing could result from collaboration between generations, bringing different skills and knowledge to the table:

“I think [...], there is a lot of younger generation with internet access, helping the parents to access the market. Some are doing that. If they’re still involved in agriculture. There’s potential to [...] access the market directly, and skip the middleman.”

Lastly, Farmer 2 and Tourism actor 1 noted that the difficulty was not in accessing the markets, as tourism guaranteed sufficient demand, but in consistently supplying it. However, the COVID-19 pandemic at the time of writing this report, would have interrupted mass arrivals of tourists, thus largely reducing the demand of food.

3.2.3. Networking in farming

All participants acknowledged the importance of networking and being part of a community of actors in the food system. Moreover, all of them were part of, or collaborated with, a peasantry association, at least one NGO, or a group of actors with similar interests.

Some of the functions of networking observed and gathered through interviews were the moral support of a community, sharing experiences and knowledge about farming, but also information about standard prices. Overall, it served to facilitate farming activities like the distribution of products, developing marketing/farming strategies and trading seeds (Farmer 2 & 3, Consultant 1, Tourism actor 2). Consultant 1 mentioned that as:

“Farmers [...] have no knowledge of the market price and what is the standard price. [...] Very important for them to network, especially if they are harvesting something they need to sale and they need to connect to each other. So they know what price to sell... Most time farmers get exploited. Networking of course is always useful. Especially in farming because you can communicate standard prices but you can also trade seeds with each other.”

If knowledge is power, building a strong network redistributes it. Developing a web of connections among the actors of the foodscape allows to share information and bypass the middleman (Farmer 1), regaining power to influence the food system.

Through observations, informal discussions, and meetings with private clients mandating the services of THK, a clear increasing desire to implement sustainable food production systems in various tourist food-related businesses was noticed and confirmed by Farmer 1, Consultant 1 and both Tourism actors. Strong networks therefore largely contribute to sharing and scaling up agroecological practices, leading to SDGs.

4. Discussion of findings

4.1. Causes of loss of attractiveness

The downward trend of agriculture in Bali is also reported by Hitchcock *et al.* (2007). He notes that Bali's agricultural sector has historically been the main activity, and thus the main source of economic well-being. In 1971, farm activities contributed 59.1% of household incomes, although with the arrival of mass tourism that number declined over the years (*ibid.*). In 2011, only 18.08% of Bali's economic growth was attributed to agriculture in contrast to 66.35% attributable to the tertiary sector including tourism (Budiasa *et al.*, 2014).

As population density rises and productivity stagnates, income from farming is shared among more people, becoming insufficient to maintain livelihoods. Thus, people are obliged to move to urban areas in search of a better life (Surjohudojo, 1973). Furthermore, Collier & Soentoro (1978) described another reason for the migration of rural people to urban areas: rising tensions and conflicts caused by declining access to land-based resources (Collier & Soentoro, 1978). Despite following governmental directions for the sake of the country (Hansen, 1971), labor intensive rice farming generated little financial reward, therefore losing its attractiveness. It is observed that many leave rural villages to study and work in urban areas, before deciding to remain in the city as professional opportunities are higher (Hitchcock *et al.*, 2007). The latter phenomenon takes away people of working age from villages and further weakens Balinese agriculture.

The millions of visitors annually certainly created many financial opportunities and greatly contributed to the island's, and nation's, economic development (Hitchcock *et al.*, 2007), but at what cost? The increase in economic well-being is largely offset by the alarming social and environmental consequences: loss of biodiversity and arable land, which reduces Bali's capacity to sustain its food production (Whitten *et al.*, 2013; Vickers, 2013; Lansing, 2006). The rapid urbanization and increasing pressure on limited land-based resources (Behnassi *et al.*, 2013; Myers *et al.*, 2000) has become impossible to sustain without significant repercussions on Bali's ecology (Whitten *et al.*, 2013). If food self-sufficiency is desired on Bali, public awareness and education is crucially needed.

If Balinese food self-sufficiency is not desired, socio-environmental tensions will continue to rise until Bali is “loved to death” (Lansing, 2013).

4.2. Lack of knowledge

4.2.1. Diversity in the production

By definition, “integrated” farming methods like agroecology and permaculture combine knowledge from various disciplines. In contrast, industrial farming methods divide tasks and crop cultures to simplify the process from a technical point of view, increasing economies of scale. Despite noble intentions of eradicating hunger and steadily elevating yields of rice (Brennan *et al.*, 2011), they are highly dependent on external inputs (Gliessman, 2015) and based on the assumptions of abundant water and cheap energy to fuel those “modern” farming methods (Altieri, 2015). Enhancing performance with ephemeral solutions created ecological imbalances (Whitten *et al.*, 2013) on top of deteriorating common resources like water and land due to mass tourism.

Moreover, conventional farming is reactive, as it finds technological solutions to existing problems. Although modern agricultural techniques are often seen as innovative (Brennan *et al.*, 2011), Nature adapts as pest’s resistance to agrochemicals increases (Gliessman, 2015). Thus, it seems like “modern” agriculture is always behind, trying to keep up with “sudden” new outbreaks. Since the 1970’s, there have been thousands of genetically modified improved rice varieties, with more being currently developed (Brennan *et al.*, 2011). This reactive strategy exposes the vulnerability of intensive farm methods. Proactive farming approaches like traditional rice growing and agroecology are more resilient to natural disturbances, thus need to be preserved with adapted political support.

Even if Consultant 1 noted farmers’ skepticism towards the uptake of new technologies, Consultant 2 explained that once farming methods have shown financial gain, adoption and application of those methods are dynamic. This has also been observed by Feintrenie *et al.*, (2010) and Whitten *et al.* (2013), even in the absence of agricultural extension actors.

4.2.2. Marketing and consumers responsibility

As more people live in urbanized areas (Behnassi *et al.*, 2011), they are increasingly disconnected, at least physically, from agriculture (Gliessman, 2015). The social conditions of workers, and the farming methods used to grow the food consumed might not be of first concern. Contrarily, it is safe to say that the price is an important criterion when purchasing a product. Therefore, cheaper products,

often grown according to methods allowing economies of scale, are preferred by default. Conforming to the laws of the market, the demand influences the offer, and thus the way food is produced. It could mean that if consumers choose more sustainably-grown products, farmers will further implement agroecological principles and respond to the demand. Therefore, the necessity to educate consumers on their/our responsibility to support, or not, the food production system desired. According to Rabhi (2008), each purchase becomes a vote for, or against, a food system, thereby reinforcing or weakening a food production model.

The consumer's responsibility is even more accentuated in Bali given the high volume of tourists, which can be perceived as an opportunity or a handicap. As aforementioned, it depends on consumers awareness and understanding of the food production system. Nevertheless, the access to markets of smallholders will be affected due to the COVID-19 pandemic. On the other hand, it might give an opportunity to reorient the type of production system, focusing more on integrated methods like agroecology as the reduced demand for food allows it.

4.2.3. Exclusion of ecological principles in policy design

With increasing corporate control of the food system, the power is further unevenly distributed (Gliessman, 2015, Altieri, 2015). In the context of agriculture, a practical definition of individual power is "the ability to control the circumstances and destiny of one's life, which is in turn critically dependent on access to and control of the resources (land, seeds, water, others' labor, etc.) needed to provide for one's needs, not the least important of which is food" (Gliessman, 2015, p.304). Accordingly, millions of farmers are powerless in favor of an elite (Gliessman, 2015), which was also mentioned by participants of the study. Farmer 1 explained farmers being defenceless against the food system, which then facilitates implementation of new technologies (Hansen, 1971; Fressoz, 2012).

Governments have the arduous function of regulating multiple objectives, which might not always be in perfect alignment. Since Suharto's "New Order", agricultural policies pushed for productivity through synthetic inputs to stimulate economic development while increasing food security (Hansen, 1971). During the same time, agrifood corporations have increasingly gained influence in the decision-making and development of legislation in accordance with their needs and self-interests (Gliessman, 2015). The latter resulted in top-down implementation of conventional farming methods, which were not well-suited for small-scale Balinese farmers.

4.3. Lack of political guidance

Although farming is a local practice, the necessity of adopting a political lens of analysis has increased significantly (Gliessman, 2015). Even more so when extensive research on the superiority of peasant-based agroecology exists (Wijeratna, 2018) but does not receive adequate political support. Bali has always been promoted abroad as a paradise like destination (Hitchcock *et al.*, 2007), contributing to its tourism development. Suharto's "New Order" prioritized economic development through intensive agriculture and tourism, which disrupted Bali's century old food sovereignty. It can be argued that economic development is preferred as food can be imported from neighboring islands like Java, which would however only delocalize the ecological imbalances created from unsustainable farming methods relying on increasingly expensive fossil fuel dependent agrochemical inputs. Furthermore, mass tourism has accelerated water shortages (Chakra, 2019) and contributed to rising social inequalities (Strauß, 2011).

Although, it would be difficult to find any politician against sustainability, social and ecological pillars are perhaps neglected in favor of economic development. Moreover, it is often unclear what precise objectives are desired and more importantly prioritized. The many political actors sharing similar but different views and interests might create a vagueness of desired outcome. This however, allows readjustment if needed, but is likely to increase ambiguous, potentially clashing objectives.

Each society has to find a balance between market freedom and governmental regulation as the cleavage is often between economic development and socio-ecological well-being once primary needs are met. Despite some environmental conservation regulations, Indonesian law enforcement, especially of environmental policies, was compared to a spider's web: "large birds can fly straight through, barely aware of its existence, whereas small flies need get only one leg caught on a sticky strand to be irretrievably caught" (Whitten *et al.*, 2013, p. 834). The context of a world pandemic might impose the necessity to assist the national's capacity to sustain itself from an agricultural point of view. Furthermore, given the restricted international mobility of goods and people, Bali's tourism sector will be negatively impacted as the necessity to feed its native population remains. The capacity of a region to feed its population has again gained importance during this global crisis as the vulnerability to rely on imports is exposed.

4.4. Trade-offs

It is often believed that institutions are inflexible towards rapid implementation of innovative bottom-up social movements, yet it has been shown numerous times, especially during global crisis, that rapid change can occur (Whitten *et al.*, 2013; Fressoz, 2012; Lansing, 2006).

Despite a growing awareness of farmers questioning the sustainability of the current production model, realizing high artificial input leads to further social exclusion and ecological degradation, the unknown outcome of adopting a new practice can be scary.

Even though precise information has convinced an individual to implement a new practice, there is still a doubt because they have not yet observed or personally experienced the positive result which convinced them in the first place. Often, new practices are adopted in times of crises, when there is no other choice left. In regard to the adoption of agroecology and sustainable agricultural methods, the risk is a lower yield, which could mean lower income until the system adapts and recovers.

5. Recommendation for further development of agroecology

After identifying some barriers to, and opportunities for, a wider adoption of agroecology, a few ways to address them are proposed in the following section. It is clear that maintaining Balinese food sovereignty has to be addressed on multiple levels.

5.1. Marketing of agroecological products

The term agro-preneur is often used as it combines the skills of farming and entrepreneurship. As acknowledged by the participants, marketing and communication proficiency are increasingly important in a globalized and competitive market. Thus, keeping updated and testing different marketing strategies like organic certifications is vital in a dynamic context.

One technique identified by the FAO (2018), which could apply to the Balinese context, is transparent price setting. This means gathering producers and consumers to discuss and negotiate a fair price covering the costs of production and the estimated value of internalized externalities. Farmers could present the socio-ecological benefits of their methods, which is difficult to rapidly demonstrate on a market. Transparency would naturally differentiate conventionally-grown products from more sustainably-grown products. The latter would justify a slight price increase and educate consumers on the repercussions of their choices, potentially increasing the attractiveness of agroecological products.

Although price is an essential factor when purchasing food, along with a growing awareness about the food system, further informing customers about health, ecological, and social aspects of the way food is grown is important. Acknowledging that through their purchase they support or move away from a food production system. Accentuating the health benefits of a nutritious and diversified wholefood plant-based diet (Gliessman, 2015; Gregor & Stone, 2015) has worked before, especially with the marketing of organic products (Paul & Rana 2012). Leaving a legacy to future generations in terms of allowing them to maintain their quality of life is also a strong ethical argument (Jonas, 2014). Most

people have children or family members who would benefit from a less degraded future environment. Supporting the community also increases customers' responsibility with regards to their consumption, as most people belong to one.

Another way to prove the higher quality of agroecological products is local certification. Third party certification schemes are often long and complicated processes, as well as not necessarily being adapted to small-scale production capacities. Farmers of this study, which are part of the organic certification scheme had to wait around two years before being certified. The International Federation of Organic Agriculture Movements (IFOAM) has developed local quality certifications, which they could benefit from. Participatory guarantee systems (PGS) include stakeholders of a short supply chain to define standards and certify product quality. NGOs and competent actors could rapidly assess farming systems according to predefined indicators of socio-ecological and economic sustainability. Then products could be labeled accordingly, increasing the transparency of information about production systems.

5.2. Political guidelines

As aforementioned, the political dimension is gaining importance beyond the farm level to assist and scale-up agroecological practices. Thus, Indonesian and Balinese authorities have to recognize and support the development of agroecology, without which socio-ecological tensions will continue to rise. Prioritizing sustainable development of agriculture on a regional and national level will allow authorities to supervise and effectively coordinate various actors involved in the process. Not one public policy is needed, but multiple complimentary ones.

Even if the Balinese population stabilizes and mass tourism decreases, the increase of consumption due to a rise in the standard of living implies an ongoing issue of unsustainable resource management (Whitten *et al.*, 2013). Therefore, officially recognizing the urgency in including ecological principles in policy design, in urban planning, tourism and agriculture. Implementing agroecology through various projects and collaboration, empowering female farmers other minorities in order to reach food sovereignty. Therefore, public awareness campaigns could help educate all actors of the food system about the socio-ecological challenges and opportunities of agroecology. The latter would aim at explaining why it is necessary, what will happen if nothing is done, and how individuals can support and be part of the sustainable development of Balinese agriculture. Agroecology can be used as a tool for climate adaption and should be included in national climate change planification.

Once officially recognized, subsidized agrochemicals should be reduced and collaboration with seed agribusinesses stopped in favor of incentives promoting

the adoption of agroecological farming methods. Strengthening peasant networks and community-based seed banks to use, sell, exchange and protect indigenous seeds and other natural resources. Financially supporting the transition towards agroecology would help to mitigating the potential risk of initial reduction of yield (Gliessman, 2015). After a while, restrictive regulations designed to move away from unsustainable agricultural practices should be implemented as negative externalities need to be compensated for. Ecological indicators should be introduced to design adapted agricultural policies, measure energy efficiency of production systems, and thus assess their sustainability.

Lastly, the Balinese political jurisdiction should be reinforced, so it can independently design, implement and regulate locally adapted policies more effectively. It could then prioritize local food systems and assist peasant social movements. To do so, participatory methods should be used which seek to include all stakeholders' interests, so a common objective can be agreed on. Moreover, these aim at including the interests of those less often heard of in this case small-scale farmers, so policies adapted to their needs can be designed. The latter increases the probability of the successful outcome of a policy, i.e. the wider adoption of agroecological practices.

5.3. Agro-tourism in the foodscape

Although tourism has increased Balinese economic well-being and significantly contributed to Indonesia's development since the 1970's, it has now moved beyond the optimum point (Whitten *et al.*, 2013). A shift of paradigm to develop long term sustainability is needed, as the current growing volume of tourists cannot be sustained. The restrictions of the COVID-19 pandemic will probably reduce tourist arrivals, but political restrictions should in addition filter and reduce yearly arrivals once the pandemic is over, so businesses can focus on premium experiences.

Hall & Gössling (2016) observed the interwind relationship between tourism, regional development, agriculture and the whole food system; thus, facilitating the strengthening of certain already existing connections between sectors (*ibid*), creating an innovative service while sharing the benefits. Furthermore, Richards & Hall (2003) note that small entrepreneurs are extremely flexible to adapt to changing consumer preferences and regulations, exploiting niches in the market and regulations (*ibid*).

As Balinese traditional agriculture is world-renowned, community-based agro-tourism has naturally emerged as a viable alternative to mass tourism. However, it has had limited success in terms of economic revenue as much of the profit leaked to the travel agencies organizing tours (Budiasa *et al.*, 2014). If adapted support from Balinese authorities is provided, its development aligns perfectly with

agroecological considerations as it aims at being “economically viable, environmentally sound, socially just and culturally appropriate” (ibid, p. 38).

6. Conclusion

6.1. Synthesis of findings

The study revealed that, despite a strong cultural attachment to farming among all participants, generating an income solely from agriculture is increasingly difficult. The qualitative research allowed the identification of a few intertwined challenges and opportunities to agroecological development in Bali. The overall lack of attractivity in farming is multi-causal: low profitability, low quality of life perceived in farming, difficulty to market added value from agroecologically grown products, loss of arable land to tourism related projects and better professional opportunities in the service sector. These factors are not exclusive but contribute to the overall disinterest of farming, thus adoption of agroecology. The second identified barrier to agroecology was the lack of knowledge among all actors of the food system. The simplified yield oriented high input dependent agriculture promoted since the GR has neglected century old traditional farming knowledge. Moreover, the lack of transparency makes it difficult for consumers to grasp their contribution and responsibility of the food system. Lastly, political actors have prioritized economic progress over ecological sustainability, thus disregarding ecological principles in the design of policies. Lack of ecological understanding, or concern is linked to the third barrier: the lack of political guidance and coordination. Balinese tourism is promoted despite alarming water shortages and loss of land-based resources. Furthermore, agricultural policies fail to include small-scale farmers interests and still promote unsustainable practices through subsidized fertilizers and hybrid varieties. The vagueness of political authorities causes weak law enforcement and no effective guidance or adapted support. Lastly, a lack of trust in political actors among the vast majority of participants due to suspected dishonest activities and corruption further hinders the sustainable development of Balinese agriculture.

In response, a few agroecological strategies have been observed and acknowledged by interviewees. The access to markets has mostly been perceived as an opportunity to effectively distribute their products. Moreover, the development of a strong network of farmers and actors within the food system

was recognized as supporting the transfer of knowledge, farming methods, seeds and overall relevant information in regard to sustainable farming. However, the COVID-19 pandemic will most probably reduce demand as tourism has momentarily stopped and affect the small-scale farmers access to markets. How Indonesian government will address these issues and support its agriculture is unknown, but it certainly encourages local and regional food sovereignty.

Developing local certification schemes to guarantee the added value of products grown according to agroecological principles, and emerging businesses like sustainable community-based agro-tourism contribute to the sustainable development of Bali. Also, designing adapted policies through participatory methods gives a voice to minorities in need of support, especially small-scale farmers largely contributing to the SDG's.

6.2. Limits of research

The internship program with an NGO allowed me to access already environmentally aware individuals. Thus, the data collection was done within a network of environmentally-educated people, who were for the most part already somehow involved in agroecological practices.

Despite attempting to include political actors to widen the understanding the problematic, the idiosyncratic sampling in addition to the language barrier limited the study. It is also obvious that as a foreigner, I would have a different understanding of the complex socio-ecological and economic context of agriculture in Bali. Moreover, it was confirmed by locals and some figures of authority during data sampling, that research in regard to sustainable development should be done by Balinese people and was none of my business. Some information was explicitly withheld from me. Nevertheless, the vast majority were cooperative and appreciated the purpose of the study. Still, only English documents and scientific literature were used, which reduced the amount of information I could access, thus potentially narrowing my perception.

In addition to the limits of the study, and as in any type of research, I brought inherent biases. Personal views and understanding can influence interpretations and analysis of collected data. The point can be made that the whole topic of research is determined by the subjective perception of the researcher. Consequently, my education, socio-economic origin, culture and values have consciously, and unconsciously, shaped the study. Yet, it seems evident that a researcher will address a topic she finds interesting and worth investigating. Moreover, the transparency of methods used, allows anyone to copy the protocol and conduct a similar study, which is the essence of epistemology and gives validity to a study. Also, it is worth mentioning that I tried to remain as objective as possible not only before and during the study, but also when analyzing the data.

Lastly, the qualitative nature and relatively small number of interviews in this research means it has little statistical significance, which was not the objective anyway. It is a contribution to the growing bedrock of qualitative research required to further increase the adoption of agroecology in Bali, Indonesia and around the globe.

6.3. Future research

The transition to agroecology is specific to its socio-politico-ecological context, yet similar obstacles are faced everywhere. Therefore, more case studies can help strengthen the validity of findings, and ideally accelerate the transfer and practical use of knowledge.

As mentioned in the data analysis section, it is essential to further assess the challenges faced by practitioners in various contexts by using different research strategies to strengthen the theoretical findings and accelerate the transfer of knowledge. The latter would allow actors of the food system to reach trigger points more effectively, accelerating the transition of agroecological theories into practice, which would help moving towards a globally sustainable food system.

Developing countries vulnerable to upcoming climate irregularities, need to rapidly increase their socio-ecological resilience; adopting agroecology could be one way of achieving this. Studying how to accelerate its adoption seems relevant while also addressing the SDGs by improving land degradation due to rapidly urbanizing areas or unsustainable land-based resource management.

To do so, qualitative research can help to identify farmers' obstacles in a specific socio-political environment with the help of political ecology. Moreover, and as stated by Mucharam *et al.* (2019), it is necessary to develop measurable indicators to compare and assess the sustainability of a food production system. Gliessman (2015) mentioned energy indicators of sustainability to measure, monitor and improve energy flow within farm systems.

Other indicators of sustainable resource management in agroecosystems, like social well-being, livelihood and ecological soil health, etc. among other long-term consequences of certain practices, also have to be included and studied (Gliessman, 2015, p.294).

Lastly, a political approach to scale-up agroecology is necessary to accelerate the transition as once farmers are in the transition, national support through adequate policies will be necessary to reward and assist practitioners' efforts and work towards a sustainable food system.

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Appendix A

Introduction:

Thank you very much to give me some of your precious time. As mentioned I conduct a research on sustainable development in Bali. I focus on Agroecology/Permaculture to understand what is done and what can be improved.

Before we start, a few formalities, I would like to record the interview to give you all my attention and do not miss out on any valuable information you share with me. You can of course stay anonymous if you desire so and choose a nickname.

Any questions?

Theme 1: Origins

Q1: Could you tell me a bit about your background?

Q2: Did you grow up in Bali?

- a. If yes: How do you remember Bali as a kid?
- b. If no: Where did you grow up?

Theme 2: Methods & support of sustainable agriculture

Q3: What does farming/agriculture mean to you?

Q4: How did you get into Permaculture/Agroecology?

- a. What benefits can you see?
- b. What are the risks?

Q5: What do you think of the Green Revolution/use of GMO's & agrochemicals?

Theme 3: Social structure

Q6: How important is networking in agriculture?

Q7: Are you part of any organization/association?

- a. If yes: Why?

- b. If no: Why not?
- Q8: Are there any challenges as a farmer in Bali?
- c. If yes: What kind?

Theme 4: Market and demand

- Q9: How does the distribution of your products work?
- Q10: What is your opinion in regard to the access to markets?

Theme 5: Governmental policies

- Q11: What is the role of the Ministry of Agriculture for you?
- Q12: What is your opinion on public funding/subsidies of sustainable agriculture?

Theme 6: Perception of the future

- Q13: How do you see the future of Agriculture in Bali?
- Q14: And how do you see the future of Agriculture?

Personal information:

1. Name?
2. Year of birth?
3. Profession?
4. Studies?
5. Is farming your main income?
6. Location of the land?
7. Surface operating?
8. Which crops are grown?

That was it. Thank you very much again for all that valuable information and your precious time.