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Farmers' Creativity and Cultivated Senses: The Immediacy of Embodied Knowledge in Alternative Agriculture

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Abstract

The Indonesian government has promoted several forms of alternative agriculture in response to the productivity orientation and top-down bureaucratic institutions in intensive agriculture. Implemented in the late 1980s, the Integrated Pest Management (IPM) marked a paradigm shift in that it focused more on human rather than technological development. Therefore, farmers were conceived as central agents of agricultural development. Government-led organic agriculture, which began in the early 2000s, combines human- and technology-centered paradigm. For the last few decades, the bureaucratization of agricultural knowledge through its regulatory institutions has removed the subjective and bodily experiences of embodied agricultural knowledge and perpetuating an uneven terrain of knowledge-making. This argument is built on the dialogical analysis of my fieldwork with organic farmers in Yogyakarta between 2017 and 2019, and a book *Seeds of Knowledge*, an ethnography on IPM farmers in early 1990s in Java. I demonstrate that through their embodied knowledge, farmers reconfigure the existing knowledge hierarchy despite the continuous radical simplification of alternative agriculture. Farmers question the validity and authority of agricultural trainers' agricultural knowledge, specifically in relation to soil quality in organic agriculture and economic threshold in IPM. The role of the model farmer in organic agriculture in bringing embodied agricultural knowledge to the fore – is central in challenging the hierarchy of "expertise." I contend the "immediacy" of farmers' embodied knowledge, which constitutes creativity and cultivated senses, by offering a critique to the notion of expertise, as a guide to an epistemological shift in alternative agriculture.

Keywords

politics of knowledge; integrated pest management; technoscience; organic agriculture; Indonesia

Exploring Alternative Agriculture in Indonesia

> Symbolic language is not understood by technical university students and university students do not understand technical issues . . . especially this [understanding of agriculture as science and culture] is important on the ground. At a university, it might be difficult to find the appropriate language, but this is

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> not the case when we meet friends (farmers) on the ground because they practice what we disseminate. (Totok, a former extension worker and an organic farmer and trainer)

On a sunny and humid afternoon in 2018, I visited Totok, at his home in Yogyakarta, Indonesia, to learn about his insights on the current state of the country's agricultural development.[1] As a leading figure in the organic agriculture and peasant movement in Indonesia for more than a decade, Totok has been active in the national and international organic agriculture movement, sharing agroecology with government agencies and smallholder farmers, and promoting organic agriculture to a wider audience. Previously, after graduating from an agricultural university, he worked as an extension worker for several years. We discussed the prevailing dichotomy between agriculture as science and technology, on the one hand, and culture on the other hand. Based on his experience working with different communities of practice, he considered this dualism, predominantly sustained in academia, to be less relevant in the "real world," where agriculture is practiced. As Totok pointed, the divergence between academics' and farmers' understanding of agriculture is signified by the lack of "appropriate language" that can bridge the above dichotomies, i.e. symbolic-material and science-culture.

This paper explores the reproduction of these dichotomies. Based on dialogical analysis (Gillespie and Cornish 2014) of my empirical work and *Seeds of Knowledge* (Winarto 2004), I trace the historical continuity of regulatory institutions which have been predicated by the disembodiment of agricultural knowledge in the past three decades.[2] I particularly focus on Integrated Pest Management (IPM) and government-led organic agriculture that I conceive as alternative agriculture.[3] In her book, *Seeds of Knowledge*, environmental anthropologist Yunita Winarto (ibid.) documented farmers' learning process during the early implementation of IPM in Java between 1990 and 1992.[4] This period marks the introduction of the Farmer Field School (FFS) in IPM [*Sekolah Lapang Pengendalian Hama Terpadu*], henceforth SLPHT. The book traces the incorporation of scientific knowledge into farmers' embodied knowledge, a dynamic process that is intertwined with a paradigm shift in entomology and the subsequent formulation of new regulations (ibid.). This book highlights how entomological investigation links the recurrent brown plant-

[1] All names are pseudonyms.

[2] A dialogical approach in interpretive social science underscores the contextual, social, and unfinished nature of meaning. Thus, context is essential in interpreting the meaning of an utterance (i.e. meaning is contextual), an utterance is stated with an audience in mind (i.e. meaning is addressive), and every utterance responds to what was said in the past and what possibly will be said in the future (i.e. meaning is temporal) (Gillespie and Cornish 2014, 436).

[3] The meanings of organic agriculture in Indonesia are contested (Schreer and Padmanabhan 2020). For clarity, in this paper, this term includes farmers who identify their produce using at least one of the following terms, organic, natural, and healthy. One common point among these terms is cultivation methods that refrain from or gradually reduce chemical inputs.

[4] Yunita Winarto's participatory research focuses on the dialectics between scientific and local knowledge in agriculture. In 2008 in Indonesia, she initiated Science Field Shop that serves as a learning platform for farmers based on collaboration between agrometeorologists, anthropologists, and farmers.

hopper infestations with injudicious spraying of pesticides on rice crops (ibid., 22). "Alternative" in this context is historically framed as an attempt to address the hegemony of productivity orientation and over-governance, which was a top-down bureaucratic institutions that disregarded farmers' knowledge and capability to be decision-makers, characteristics of the Green Revolution which, to a certain extent, persist in Indonesian agriculture to this day (Winarto 2011, 298). As further elaborated in the following sections, the Green Revolution was the Indonesian government's strategy in the 1960's to achieve food security through the industrialization and intensification of agriculture.

This paper also draws upon my dissertation research in the Special Region of Yogyakarta, Java, between 2017 and 2019, specifically in two regencies, Sleman and Kulon Progo, which are located on the north and west of Yogyakarta City (Laksmana 2023). In my fieldwork, I observed the technological- and human-centered paradigm in organic agriculture in the interactions between "model farmer," government officials, and snake fruit farmers who were the beneficiaries of the "1000 Organic Villages" program in Turi district as I elaborate in the following sections. In total, I spent about nine months of fieldwork conducting participant observation and in-depth interviews with organic farmers, extension workers, and government officials from the Department of Agriculture in the district of Pakem, Turi, Cangkringan, and Kokap, which belong to the two regencies. Most organic farmers I engaged with were smallholders, for instance landowners and landless agricultural labors, who grow vegetables and paddies. Smallholders are characterized by plurilocality and pluriactivity, signifying farmers' multiple sources of income and experiences of periodic migration (White 2020). During my ethnographic fieldwork, which was conducted through several visits, I stayed with three different farmer families in three different villages. One of them is a snake farmer in Wonokerto (I will elaborate below), another a vegetable farmer in Purwobinangun, and the third, a coconut tapper in Hargotirto. I learned about their agricultural practices and knowledge, but also their everyday experiences and their reflections on how their knowledge is perceived by scholars, government officials, and other farmers.

Since organic agriculture became a trendy social phenomenon and research agenda coincided with its institutionalization in the early 2000s, farmers noticed that they were approached more often by researchers. In this context, my positionality as an Indonesian doctoral researcher from a German University triggered mixed responses among farmers. As they assumed German agriculture is "developed" (cf. Gupta 1998), they were curious to learn from me about German agriculture which they associated with advanced machineries, and simultaneously, were puzzled by a German University's interest on their agricultural practices and knowledge. In addition, due to the government's programs to invite model farmers as speakers at organic agriculture workshops and to bring organic farmers to visit "successful" organic farms, these farmers were more used to opportunities to meet other farmers in the country. These experiences that

farmers have shape their subjectivity, which together with regulatory institutions, influence what agricultural knowledge circulates at a regional, national, and international scale.[5]

Following dialogical analysis, the moves between voices of mine, Winarto's, my research subjects, and of her research subjects in this article are characterized by constant (re-)interpretation that leads to the emergence of new insights. As a result, I propose the embodiment of agricultural knowledge as an alternative way to think about "alternative" agriculture (cf. Santos 2018). This approach is in contrast with previous studies that frame alternative agriculture in terms of institutional and technological innovation (for example, Barragán-Ocaña and del-Valle-Rivera 2016).

The rest of the paper is structured as follows. I begin with discussing the politics of knowledge in agriculture. I link it with the conceptualization of embodied knowledge and the way it is mobilized to critique disembodied scientific knowledge. I then elaborate on the emergence of IPM and organic agriculture in Indonesia as in response to problems encountered during the Green Revolution. I illustrate the embodiment of farmers' agricultural knowledge in alternative agriculture using the examples of economic threshold in IPM and soil quality in organic agriculture. I introduce the notion of "immediacy" to underline the significance of farmers' embodied knowledge in knowledge intermediation during their encounters with state and non-state actors. I then argue *how* reductionism in alternative agriculture happens through what James Scott (1998) considers as "radical simplification of agricultural high modernism" where agriculture is governed for primarily yield maximization. This process reflects the persistent global hegemony of the Green Revolution paradigm that depends on the bureaucratization of agricultural knowledge. As a result, agriculture is fragmented into various disciplines and agricultural knowledge is transformed from embodied to disembodied. I demonstrate how farmers through their embodied agricultural knowledge challenge the hierarchy of "expertise." I conclude by suggesting farmers' embodied knowledge may guide "alternative thinking" about the practices of alternative agriculture.

Politics of Knowledge in Agriculture

Knowledge production in IPM and government-led organic agriculture are embedded in the interactions between science, regulatory institutions, and society. Rooted in the hierarchization of heterogeneous knowledges that are contingent to specific contexts (Nygren 1999), agricultural knowledge is characterized by hybridity and contestation. For example, Akhil Gupta (1998), an anthropologist, discovered that farmers in western Uttar Pradesh evaluate the effects of chemical fertilizers and manure on soil quality by drawing on "scientific" and "indigenous" understandings of agriculture and on the politics of production relations. Ian Scoones and John Thompson (1994) introduce "beyond farmer first," a perspective to conceptualize the interlinkages between power, knowledge, and agriculture. Since the circulation of agricultural knowledge is dynamic, they advocate dialogues between different knowledge arbiters who have divergent goals and access

[5] Regulatory institutions are understood as political decisions based on science which have origins and/or implications associated with politics (see Brown 2015).

to resources, and whose interactions are politically and socially situated (ibid.); an approach that foregrounds the social dimension of knowledge is often referred to as "knowledge as process." Adopting this theoretical approach, Bina Desai (2006) demonstrated the co-constitution of agricultural knowledge and the formation of expertise in agricultural extension.

In this paper, I refer to "knowledge intermediation" (Davies, Nutley, and Walter 2008) to analyze how intersubjective interactions and existing regulatory institutions promote engagement between multiple actors with different sources of agricultural knowledge. Building on the aforementioned studies (Gupta 1998; Scoones and Thompson 1994; Desai 2006) that center practice in knowledge construction, I investigate the "politics of knowledge" in alternative agriculture by asking: *What are the implications of viewing the technoscientific world of alternative agriculture through the lens of farmers' embodied knowledge?* Agriculture as technoscience implies a temporally and spatially contingent practice that transcends the conventional association of science with knowledge and technology with material production (Heath and Meneley 2007). This framing conceives agriculture as a site of contestation between ways of knowing and making, in which broader societal conditions and existing knowledge are brought into play into what Sheila Jasanoff (2004) proposes as the co-production of science and politics. In this context, I conceptualize regulatory institutions of alternative agriculture as technoscientific regimes of power as they perpetuate an uneven terrain of knowledge making through transforming embodied agricultural knowledge disembodied.

Recent studies in cognitive sociology demonstrate a shift from amodal towards embodied theories of knowledge due to the former's inadequacy in explaining the subjective and bodily experience of knowledge (Ignatow 2007). Knowledge as embodied, in this article, means bodily sensations of experiences are partially stored as conceptual and perceptual representations instead of transduced into mental representations independent of perception and sensation as the amodal theories suggest (Barsalou et al. 2005).

In science and technology studies (STS), embodied knowledge is central in challenging uneven terrain of knowledge-making in institutions, such as an animal health service (Gundermann 2017), and chemical safety regulations (Murphy 2017), that deny embodiment. Laboratory studies problematize the labor division between scientists and lab technicians (Heath 2007), highlighting the significance of embodied knowledge in scientist training (Myers 2008), and linking it to scientific practices and institutions (Jeon 2019). Concerning the intersection between environmental justice and social movement, communities' experiences of bodily harm from pesticide spraying drove the deployment of counter-expertise, which involves a community-scientist alliance, to challenge environmental injustice (Arancibia and Motta 2019). Fundamentally, most of these works attempt to revise the notion of disembodied scientific knowledge by challenging the dominant dichotomy between "knowing" and "doing" in knowledge-making and knowledge acquisition in (technology-mediated) sciences.

Building on them, I highlight the "immediacy" of farmers' embodied knowledge as knowledge that emerges from and is manifested through their creativity (Winarto 1995) and cultivated senses (Paxson

2013).[6] By "immediacy," I mean a conscious engagement in an instance of particular situations, while reflecting on the past and anticipating the future. By taking temporality and subjectivity as its foundation, this conceptualization foregrounds the hybrid and contested features of agricultural knowledge (Gupta 1998). My argument serves as a critique to the notion of expertise, thus is crucial in envisioning epistemological shift in alternative agriculture.

From the Green Revolution to Alternative Agriculture

This section highlights a series of paradigm shifts in Indonesia's agricultural development. The Green Revolution adopted a technological-centered paradigm in agricultural intensification, whereas IPM was informed by human-centered paradigm in pest management. Following a narrative of ecological modernization of sustainable development, government-led organic agriculture adopted a technological- and human-centered paradigm. Using the example of pest management, I demonstrate how farmers' experiences of being subjected to previous government's programs influence the articulation of their creativity.

Paradigm Shifts in Agricultural Development

As briefly mentioned above, the Green Revolution was implemented in Indonesia in the 1960s as a national strategy to boost food production through the intensification and industrialization of agriculture (Sawit and Manwan 1991). This target was accomplished through a combination of technological packages distributed to farmers (containing high-yielding varieties of rice and chemical pesticides and fertilizers), large-scale irrigation schemes, and technocratic institutions (Fox 1993). In addition to this technological-centered paradigm, extension workers instructed farmers to synchronize their planting and harvesting using standardized and input-intensive techniques (Sawit and Manwan 1991). The notable achievement of this program was that the growth of food production exceeded population growth between 1969 and 1990 (Arifin 2008). However, from the mid-'70s onwards, rice crops were affected by recurrent outbreaks of brown plant-hoppers (figure 1), due to indiscriminate spraying of chemical pesticides. This phenomenon motivated the issuance of Presidential Decree No.3-1986 on the Improvement of Brown Plant Hopper Control on Rice Crop, which prohibited the use of 57 insecticides on rice crops and initiated IPM implementation (President of the Republic of Indonesia 1986).

[6] Creativity in this context consists of trial and error in cultivation practices, as well as the evaluation *of* and inferences *from* the results of ones' experiments, and comparisons of variations in plant performance and farming strategies – all of which are essential in knowledge acquisition (Winarto 1995, 52). Cultivated senses are acquired through "... a reflexive feel for strategic action under contingent circumstances" (Paxson 2013, 136).

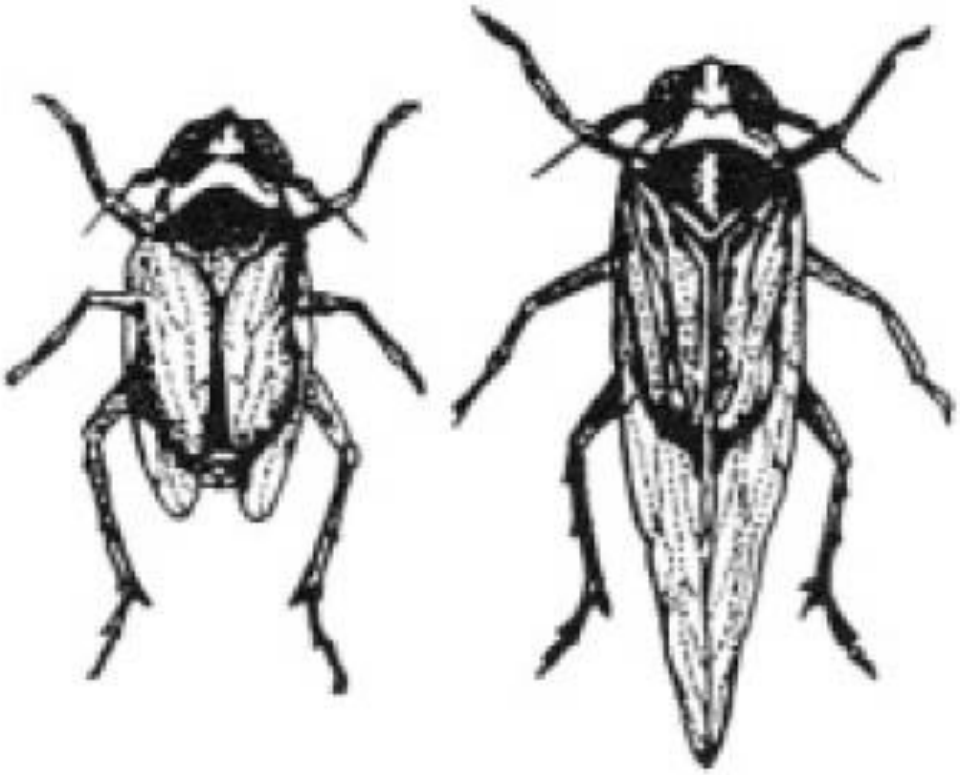

Figure 1: These are the images of nymph or juvenile and adult brown plant-hoppers (Source Reissig et al. 1986, 259, published with kind permission, utilizing the CC BY-NC-SA 4.0 Creative Commons license).

As a global initiative promoted by the Food and Agriculture Organization (FAO) in the early 1970s, IPM aimed to solve the growing problem of pest outbreaks in the Global South through new ways of managing pests that combine biological and cultural control of pests and the judicious application of chemical pesticides (Sawit and Manwan 1991). In Indonesia, the implementation of SLPHT marks a broader shift in the government's strategy for agricultural development, from technology distribution towards human development, giving farmers a central role as agents in the development process (Winarto 1995). As a result of the government's change of tone in agricultural development, entomology and adult learning, which include field observation and experiment, formed the basis of the IPM curriculum in the nationwide training program for pest observers from the Directorate of Food Crop Protection and Agricultural Extension in 1989 (ibid., 25–27). The ecological understanding of insect dynamics promulgated through SLPHT, thus, emphasizes field observation and experiential learning of farmers.

Contrary to IPM, government-led organic agriculture in the early 2000s was driven by a vision of environmentally sustainable agroindustry, to take advantage of the global organic market that increased

from 15.2 billion to 50.9 billion US dollars between 1999 and 2008 (Sahota 2010). It was also a response to the decline in soil carbon content, nutrient, and biodiversity as a result of intensive agriculture (Amelia et al. 2018). Extension workers often talk about these effects in terms of "soil quality"; farmers' embodied knowledge conceptualizes these issues quite differently, as I describe in the next section. The sustainable development discourse, particularly ecological modernization narrative, of organic agriculture (Laksmana and Padmanabhan 2021) is apparent in the first national program in organic agriculture, entitled "Go Organic 2010," whose aim was "... to accelerate the agribusiness development with environmental orientation as a way to improve the welfare of people, especially farmers" (Ditjen BPPHP 2005, 3).

Farmers' Creativity – Knowledge on Pest Management

By looking at farmers' creativity (Winarto 1995) of trial and error in cultivation practices, I show how the relations between IPM and organic agriculture can be exemplified by their distinct pest management practices. Winarto observes that within two years (1990–1992) of the introduction of SLPHT, farmers at her field site identified white stem borers as rice pests (2004, 4). In contrast, she further describes that before IPM—

> ... farmers did not understand that larvae hatched from the egg-clusters that were laid by white moths caused these symptoms [deadhearts and whiteheads]. ... Without any knowledge of the white stem borer's reproduction, farmers did not understand that those thousands of white moths would cause severe damage to their plants (ibid., 1).[7]

[7] Deadheart and whitehead are symptoms of infestation by rice stem borers during the rice plants' vegetative stage (i.e. the stems) and reproductive stage (i.e. the seed heads), retrospectively (figure 2).

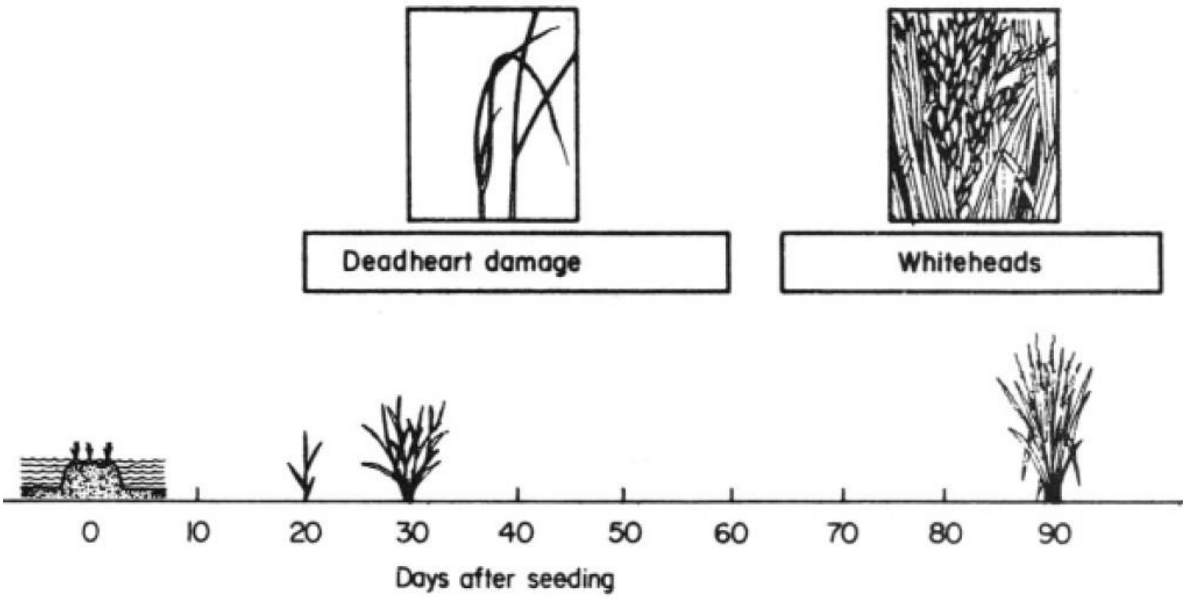

Figure 2: The image on the left shows deadheart which is damage on rice plant caused by the larvae of white stemborers that penetrate a tiller during the plants' vegetative stage. Deadheart is indicated by brown tillers. The image on the right shows whitehead which is indicated by white and empty panicles. It happens when the larvae of white stemborers infest rice plants during generative stage (Source Reissig et al. 1986, 139 published with kind permission, utilizing the CC BY-NC-SA 4.0 Creative Commons license).

Therefore, farmers' new understanding of white stem borers is a major achievement of IPM as alternative agriculture because the occurrence of whiteheads, in combination with other factors, such as soil properties, fertilizer use, and rice variety, affect yield (Winarto 1995). This new understanding complements farmers new knowledge on judicious spraying of chemical pesticides.

The importance of experimentation and attunement to observable changes on the farm in organic agriculture, was explained to me by Karim, an organic farmer and independent extension worker (known in Indonesia as *penyuluh pertanian lapangan*, henceforth PPL) who previously participated in SLPHT, the relationship[8] between IPM and organic agriculture is that—

> The capacity of PPL on organic agriculture should come from SLPHT . . . In SLPHT the focus is on farmers' understanding of pests and diseases and protection measures. The priority of protection measures should be to return to nature. So, we (extension workers) introduced *agensi hayati*, for instance PGPR [plant-growth promoting rhizobacteria], *Paenibacillus, Beauveria bassiana*, etc. SLPHT graduates should know about these.

[8] A distinction is made between independent extension workers (PPL swadaya) who work on a voluntary basis and extension workers (gain a monthly salary) and are employed by the government.

Karim's explanation corresponds to the latest organic standard, which instructs that pest management should prioritize prevention through various mechanical and biological methods, such as intercropping, crop rotation, conservation of pests' natural predators, and the use of biological agent (BSN 2016, 11). These techniques that emphasize farmers' on-farm decision-making are also taught in IPM (van de Fliert 1993). However, chemical pesticides are strictly banned in organic standards, whereas they are still allowed in IPM. The expanded use of scientific knowledge developed for IPM by organic agriculture is particularly evident in the application of biological agents (*agensi hayati*). In IPM, they are only used to control pest populations, as in the case of *Beauveria bassiana* fungi which can kill insects by infecting them (McKinnon et al. 2018). In contrast, in organic agriculture, the inoculation of PGPR into plant roots is intended to boost plant growth (Backer et al. 2018), as Karim mentioned.

The above exposition shows that human-centered paradigm in IPM and organic agriculture regard farmers' ability to experiment, observe, and respond to the conditions on their fields as crucial. Moreover, farmers' creativity is influenced by their long-term routine in conventional agriculture and the different orientations of previous government's programs that they were subjected to. For example, the new pest management strategies that IPM introduced to farmers through field observations were successful in introducing the life cycle of white stem borers to farmers. These strategies were adapted to organic agriculture as Karim's experience on the application of biological agents shows. In the next section, I elaborate on how farmers' embodied knowledge is central in our understanding on the dynamic interactions between government officials and farmers in knowledge intermediation.

The Corporeality of Agricultural Knowledge Among Farmers

> . . . discussions with my laboratory colleagues, along with my own hands-on experiences in the lab, reveal the persistent division between mind and body in technoscientific practices. Yet the same interlocutors also present critiques of the dominant paradigm. These counter discourses . . . accord significance to an intuitive, corporeal knowledge that, while embedded in practice, is nonetheless conscious and socially transmissible . . . knowledge that is embodied in material practice, not held at distance by a disembodied mind. (Heath 2007, 140).

The above excerpt from Deborah Heath's laboratory fieldwork illustrates that the disembodiment of scientific knowledge is still predominant, yet it continues to be revised within scientific institutions. I agree with Winarto (2004, xv) that the incorporation of scientific knowledge into farmers' (embodied) knowledge is a multidirectional process that involves mutual learning between scientists and farmers. I present two examples of how this process takes place in farmers' interactions with agricultural trainers and their long-term observation on different farming techniques. The first case is the transformation of the economic threshold level (ETL), a key concept in IPM, as it was incorporated into IPM farmers' knowledge. The second example is the organic farmers' tactile and visual evaluation of changes in soil quality due to the application of organic fertilizers.

Economic Threshold – from Disembodied to Embodied Concept

I exemplify "knowledge intermediation" (Davies, Nutley, and Walter 2008), a process that facilitates constructive interactions between different knowledges, through the shift of meaning of ETL, from

economic to agroecosystem analysis. During her field observations, Winarto noticed that IPM trainers encouraged farmers to evaluate the need for pesticide application based mainly on "whether the pest population had reached the economic threshold level (ETL)," instead of using agroecosystem analysis (2004, 149). ETL is defined as the level of yield loss beyond which it is economically feasible to control a particular pest through pesticide spraying (van de Fliert 1993). As an economic analysis, the value of ETL is specific to crops, pests, and pesticides. However, in SLPHT, Winarto observed that IPM trainers omitted reference to economic factors such as cost and yield, and re-defined ETL values based on assessing the observable damage symptoms that farmers associated with them (2004, 149–150). As a result, farmers' decision to spray pesticide was informed by "the number of pests, the level of pest attack and damage symptom" (ibid., 151).

The IPM trainers placed a different emphasis because they were trained in entomology, and unfamiliar with the economic concepts underpinning ETL, as Winarto argues (ibid., 152) with reference to the work of Elske van de Fliert (1993), an FAO expert, who evaluated the implementation of IPM training in Central Java. I push this argument further by suggesting that this encounter does not only signify the inadequacy of IPM trainers' knowledge that led them to re-adjust the training. More importantly, IPM's human development paradigm facilitates constructive interactions among different knowledges. Therefore, based on IPM trainers' reflection on the epistemology of farmers' agricultural knowledge, they recognized that ETL is based on disembodiment. It involves an abstraction that transduces farmers' perceptual-subjective experiences of weather conditions, pests, and plants in their fields into an amodal symbol in the form of discreet numbers that farmers need to memorize (cf. Agrawal 2002). On the contrary, the emphasis on observable symptoms introduces a perceptual aspect to the concept, turning ETL from a disembodied to an embodied concept, thus making it more readily incorporated into farmers' agricultural knowledge.

Following the initial introduction of ETL, Winarto observed that in the subsequent training sessions (2004, 152–153), IPM trainers abandoned calculation-based approaches altogether due to their lack of success. Instead, they set up a group exercise in which farmers were asked to decide on an appropriate intervention for a rice field in circumstances defined by a set of variables including weather conditions, rice variety, plant age, the type of pest, and the presence of natural predators (ibid.). One IPM farmer who participated in this exercise explained his rationale for not spraying:

> The rice variety is resistant, there are no natural enemies, the weather is hot, the immigrants are few, the insects are at mature stage. . . . Our conclusion: brown plant hoppers do not need to be controlled, because the variety is resistant and the weather is hot (ibid., 154).[9]

While this group discussion depicts a hypothetical situation and the trainers did not explain the relations between these conditions, Winarto argues that farmers' ability to establish the relations among these variables is derived from their past experiences (ibid., 152). She further explains that farmers combined their

[9] As explained in the book, the term immigrants refer to the incoming insect pests (ibid., 152).

experience and empirical evidence to incorporate the concept of natural enemies, i.e. predators of insect pests (another important concept in IPM) into their agroecosystem analysis (ibid., 153–154). Building on Winarto's analysis, I argue that the concept of natural enemies was incorporated into farmers' embodied knowledge through their creativity, which combines *conceptual representation* (the relations between various conditions in the hypothetical exercise) and *perceptual representation* (their experience of growing rice), and the willingness of IPM trainers to recognize the embodiment of agricultural knowledge.

The above example highlights the dependence of knowledge intermediation on intersubjective interactions and existing regulatory institutions. The dialogical learning between farmers and IPM trainers as scientists/bureaucrats led to the incorporation of ETL into farmers' decision-making. In this process, a scientific concept that was initially disembodied became embodied. Another outcome was farmers assessed the severity of pest attacks by describing their observations of average numbers of insects and their natural enemies using terms like "a bit numerous" instead of a discreet number (ibid., 161). This subjective expression of estimation and "feeling" (ibid., 182) of their embodied knowledge, I argue, is not arbitrary. On the contrary, they are shaped by the cultivated senses that are conscious and socially transmissible as the following section further elaborates.

Tactile and Visual Evaluation – A Matter of Experience

One change commonly mentioned by organic farmers after switching from chemical to organic fertilizers – for several years – is that the soil structure becomes more porous and less compacted. This condition facilitates manual plowing with hoes. Similar observation is typically shared by organic farmers who previously practiced conventional agriculture.

During the first few weeks of my fieldwork in 2017, I was recommended by numerous organic farmers and extension workers to meet with Samin who is an experienced organic farmer and a seed breeder of local rice varieties (e.g. *cempo merah* and *cempo hitam*).[10] In our numerous conversations, he shared his agricultural knowledge and life history of migrating to big cities. Samin decided to focus on farming after moving back to his village to marry his wife in the 1980s. Initially, he farmed conventionally on several paddy fields that he inherited from his parents and rented from village officials. It was not until 2003 that he gradually reduced the application of chemical fertilizers on his fields, after attending a training course on "environmentally-orientated agriculture" in his village. He replaced chemical fertilizers with cow and goat manure and reincorporated the rice straws back into the soil after every harvest. As a landowner and sharecropper, Samin described the difficulties he encountered in the 1980s when he still used chemical fertilizers—

> I tilled in the year of '80, '85, or '87, '88; it was very hard to till [the soil], because, if the hoe was not right, not really sharp, it quickly felt painful here (he pointed to his wrist), because the soil was very hard.

[10] Other names for these rice varieties are *sembada merah* and *sembada hitam*. They are red and black rice.

This period marked the expansion of rice intensification programs, targeting farmers across Indonesia, but especially in Java, as the island has always been one of the country's food production centers (Arifin 2008). However, when he started applying organic fertilizers, the first thing that he noticed was that the soil in his field became looser and less compacted after a few harvests.

Samin also made an astute observation on the link between the change in soil structure and the durability of *pematang* or dykes on his paddy field. I was fascinated when he described how—

> In the '90s, I grew chili peppers in that field of more than two hectares. The dykes were seldom damaged. After we used a lot of organic fertilizers (since 2003), used liquid organic fertilizers, then the [rice] straws were frequently returned to the field, the soil became gembur (loose), but the dykes sometimes got damaged . . . so every planting season [they] have to be repaired.[11] . . . You can try to ask Faris (another organic farmer in his farmer group) if is it true that the dykes often get damaged because it (the soil) has become loose. [His] answer will be the same. On average. However, people seldom observe this. In the end, because the soil starts to become good, to be loose, the dykes are frequently damaged, it is *wajar* (reasonable). Because loose soil is *empuk* (soft). Just imagine it, [when] the soil was hard like in the '80s, '90s I seldom saw damaged dykes. Now, it is more common . . . Unless there was a flood, then they were damaged.

I would argue Samin's explanation for his observations highlights the corporeality of agricultural knowledge. With reference to the work of Paxson (2013, 136) on cultivated senses, his visual and tactile evaluation of the relations between organic fertilizer use, soil structure, and other perceptible changes in his fields is derived from his *reflexive engagement* with the material world and his *cumulative experience* of farming in the same area for over four decades. Notably, his embodied knowledge was acquired during his seed breeding activities in his village. During my fieldwork, he was the only rice seed breeder in the village. To this end, he set aside a few square meters of farmland for selectively breeding rice plants, using seeds from plants with the desired characteristics, such as uniform plant height, high yield, and resistance to pests. In addition to cultivated senses, Samin's expertise relies on creativity through which he evaluates and compares the experiments (Winarto 1995).

Furthermore, a farmer's learning process is also related to politics of production relations, in terms of landownership and labor position, that structure risk aversion towards trial-and-error in farming activity and its inherent uncertainty (Gupta 1998). While landlords may not always directly intervene on farming, the change in agricultural outputs, especially yield reduction associated with experimentation may jeopardize the relation between landowners and tenant farmers. This is because sharecropping where tenant farmers pay the rent in the form of crops or labor is a common practice in Java. In Samin's case, he

[11] In this conversation, he explained that after the infestation of yellow mosaic virus that causes the yellow mosaic disease to chili peppers in 2002, he converted the chili pepper into a paddy field. Because of the abundance of water in his village, it is possible to grow rice all year long, whereas in other villages planting season is determined according to water availability and monsoon seasons.

specifically assigned the field that he inherited from his parents, but not the rented ones, for his seed breeding experiment.

Embodied knowledge also guides present action considering past experiences and anticipated future, or what I consider as "immediacy." After making the observations cited above, he explained that frequent damage to dykes is dangerous as rainwater can wash away the fertile topsoil through gaps in the dykes. In addition, the repair of the dykes represents an increase in production costs. Nevertheless, he accepts this additional, unintended cost of using organic fertilizer as reasonable, as the benefit of improved soil structure overtime outweighs it, and the dykes can always be repaired whereas improving soil quality takes a long time. Samin explained that farmers in his village adapt to this change by growing *kolonjono* grass (*Penissetum purpureum*) on the embankment of their paddy fields, as the roots of this grass can hold soils, and the grass can be used as livestock fodders.

The above examples do not only underline what Winarto (2004, 352) argues as the limitation and incompleteness of farmers' knowledge (and the partiality of the knowledge of agricultural trainers). More importantly, the immediacy of farmers' embodied knowledge highlights the interlinkages between temporality and subjectivity in knowledge intermediation. The intersubjective experiences of IPM trainers and farmers in negotiating the meaning of ETL show how farmers' reflections embodied in their farming experiences guide constructive interactions between different agricultural knowledges. Through organic farmers' evaluation on soil quality on organic fields, I show how their responses to changes in the environment and broader institutions reflect the hybridity of agricultural knowledge.

However, it should be noted that this dynamic interaction exists within regulatory institutions that facilitate heterogenous knowledges and, simultaneously, perpetuate an uneven terrain of knowledge-making as three decades of alternative agriculture and its co-existence with intensive agriculture in Indonesia have shown. Soil degradation and pest outbreaks due to overuse of chemical fertilizers and pesticides are still widespread. In Java between 2009–2011, and also 2013, outbreaks of brown stem borer have been attributed to injudicious use and lax regulations of chemical pesticides, among other factors (Winarto 2016). In addition, the institutionalization of organic agriculture extends the Green Revolution paradigm of productivity orientation and centralized government to environmental conservation (Laksmana and Padmanabhan 2021). The next section examines how radical simplification of alternative agriculture takes place and its implications on politics of knowledge.

Regulatory Institutions as Technoscientific Regimes of Power

> When I joined Adma's group in week VI of IPM training, Wira told me that "The PPL should cultivate rice by himself." "So that the other farmers can observe it," agreed Ardi. . . . Akim said that, first, there should be evidence to be observed: "For example, there is a successful performance [of rice farming] . . . The PPL should not just 'talk' like that. Hence, we can see [the results] ourselves." This conversation illustrates how the farmers perceived the trainers as "expert-outsiders" who were only "talking" without "doing." (Winarto 2004, 163).

Building on the above discussion on the contested and hybrid characteristics of farmers' embodied knowledge, this section examines how regulatory institutions as technoscientific regimes of power transform embodied agricultural knowledge disembodied. I refer to James Scott's (1998, 262) discussion on

the conditions that contribute to "radical simplification of agricultural high modernism" for the purpose of yield maximization which is a continuation of the paradigm underpinning the Green Revolution in alternative agriculture. This process depends on the bureaucratization of agricultural knowledge.

Linking Expertise with Authority and Validity of Agricultural Knowledge

Scott (ibid., 290–291) argues that the underlying logic of states' schemes are power consolidation in centralized government and reduction of cultivators' autonomy. For "professional" reason, "the more the cultivator knows, the less the importance of the specialist and his institutions" (ibid., 319). Following this argument, institutions tend to serve those in power, whereas the shift in the epistemological basis of governing agriculture may influence the question of expertise, thus making the state less relevant. As the circulation of agricultural knowledge is politically and socially situated, I focus on the ways farmers reflect on and negotiate the authority and validity of the agricultural knowledge of IPM and organic trainers despite the above logic.

Despite the knowledge intermediation that IPM facilitated, it was predominantly informed by science that upholds the dichotomy between "knowing" and "doing" as evident in the selection and authority of pest observers and IPM trainers. Pest observers who were trained in entomology have the power to decide on the application of pesticides in specific situations, including the dosage and types (President of the Republic of Indonesia 1986). As Winarto remarks:

> The main trainers were selected not from among extension workers but from among pest observers – officials from the Directorate of Food Crop Protection – who had never before had direct communication with farmers. . . . The pest observers' main tasks were monitoring the conditions of pest populations and disease infestation on food crops and providing suggestions to local regional officials of the necessary management steps to take. . . . The pest observers, therefore, became resource persons for pesticide use. . . . Few of them had ever grown their own crops . . . (2004, 26).

Another way regulatory institutions maintain differentiated authority can be observed in the interactions between IPM and non-IPM farmers. In her fieldwork, Winarto met two IPM farmers, Ayim and Idham, who experimented with a particular pest reduction method in their fields and assessed how it affected yields and the cost of production (ibid., 209). Based on this experience, they considered themselves as "more appropriate sources of information" than extension workers (ibid.). Ayim's rationale was that—

> If only the PPL talks, the farmers won't believe them 100%. What does the PPL know? He only sits behind a desk. Behind a desk, so, if the farmers themselves present the words, the other farmers might believe what is said. Maybe not 100%, but they might believe it because I have tried it myself. (ibid., 209–210).

Idham agreed with this line of reasoning; however, according to Winarto, "he was aware that his position was subordinate to the extension worker" (ibid., 210). She interprets this as evidence of the farmers' awareness of "their ambivalent position," where (to paraphrase her), in relations with other farmers, their good grasp of these farmers' epistemology comes up against their lack of authority as ordinary people (ibid.). In Java, particularly in rural societies, government officials are perceived as authority figures due to the historical, political, and cultural context (Antlöv 2010). In addition, authority of the agricultural knowledge

of pest observers and extension workers originates from the formal education they pursue as expertise is conferred by power relations, such as those embedded in expert networks and institutions (Levidow and Boschert 2011, 14).

The simplification of alternative agriculture can also be illustrated by the validity of agricultural knowledge that IPM trainers circulate. Winarto explains that the IPM farmers she observed appreciated the knowledge gained on the life cycles of pests and predator–prey relationships among insects and are aware of "the inadequacy of their knowledge to solve unforeseen problems and risks" (2004, 162). Nevertheless, the same farmers considered IPM trainers to be outside experts and were prepared to question the validity of their knowledge. Winarto explains that this conflict arises from the fact that IPM knowledge, in farmers' perspective, "still existed at the narrative level" as it was introduced as "propositions and methods already established by scientific procedures outside the farmers' experiences" (ibid., 163). In other words, when IPM knowledge is only transmitted orally or textually, it is disembodied as it is only represented conceptually, but not perceptually. A similar argument was explained to me by an extension worker who shared his experience of convincing farmers of the benefits of organic agriculture. He told me:

> So if our farmers are only given knowledge, they do not believe it. But if we take them to the field, they learn there, directly, there are many worms (he pointed at the ground), more, [the soil is] more fertile, there are more tillers [they are convinced].[12]

As farmers validate knowledge they are presented through empirical experience and experimentation, they develop varying degrees of acceptance of IPM knowledge (ibid., 85, 164). Therefore, when farmers question the validity of agricultural knowledge of IPM trainers, it is not because they do not acknowledge its benefits or feel that accepting this new knowledge would discredit their existing knowledge (ibid., 162). I argue it is the disembodiment of this scientific knowledge that leads them to call IPM trainer's agricultural knowledge into question.

The fact that most pest observers did not have farming experience yet had the authority to decide on pest management measures led farmers "complained about the incomplete information" (ibid., 167). Despite the inclusion of crop and nutrient management and learning-by-experience in IPM methodology (President of the Republic of Indonesia 1986), I argue that the emphasis here is on the agricultural experience of farmers, but not the trainers. Consequentially, farmers "perceived the training as concentrating more on controlling pests than on rice farming in general" (Winarto 2004, 167). Her commentary on this phenomenon is that, for farmers, "rice farming is an integrated activity that cannot be fragmented as it is in agricultural bureaucracies and sciences" (ibid.). I argue that fragmentation leads to the decontextualization of embodied (agricultural) knowledge, whereby its intuitive-subjective and relational characteristics are obscured (Lin, Bates, and Goodale 2016). Thus, the documentation and circulation of agricultural knowledge, for example through training modules, standards, or policies, remove the subjective

[12] Tillers are the grain-bearing branches of rice plants.

and bodily experience of agricultural knowledge (Agrawal 2002). In the example above, entomology discounts the relations between life cycles of pests and broader practices of crop cultivation, soil preparation, nutrient management, and seed selection in agriculture. Therefore, the continuation of the Green Revolution's consolidation of power by centralized government is evident in the fragmentation of agricultural knowledge in IPM. Winarto notes that, in other training sessions, IPM trainers and staff of Rural Extension Centers (BPP) and national agricultural agencies reduced ecosystem analysis back to the memorization and calculation of ETL values (2004, 156).

Such radical simplification to agriculture can also be observed in the government-led organic agriculture program that I describe in the following section. The roles of a "model farmer," however, shed light on a different dynamic in politics of knowledge.

Model Farmer

In 2015, the Ministry of Agriculture launched the "1,000 Organic Villages" program to provide organic certification to 1,000 villages across the country (Plantation General Directorate of the Ministry of Agriculture 2016). This program combined technological packages comprising organic inputs and machinery with training events for organic trainers and farmers following FFS (ibid., 21–25). Like IPM, training and support from this program were provided to farmer groups in the villages.[13]

Given the ambition and scale of the program, I examined its implementation from 2018 in Wonokerto village, within the Turi district. I gained insights about this program from my stay in that village and conversations with Eka, an organic snake fruit farmer from Yogyakarta, who was hired by the Department of Agriculture in his province as an organic trainer at the start of the program in 2015. I knew Eka since the beginning of my fieldwork in 2017 since he was often asked by his farmer group and national network on organic agriculture, the Indonesian Organic Alliance to give talks about organic agriculture in Yogyakarta. In November 2018, Eka introduced me to the Fajar Mulia farmer group who were one of the beneficiaries of the "1,000 Organic Villages" program. When I asked about his involvement in the program, he explained:

> So *dinas* (the Department of Agriculture) chooses people with known backgrounds . . . who have already been involved in organic activities. Then they are selected to become organic trainers.

He further explained that most trainers are organic farmers in the area, and some even volunteer as independent extension workers. He also added that from the perspective of *dinas*, he was perceived as "experienced" in organic agriculture, as he successfully applied for organic certification for his farmer group. As third-party certification, which is both political and science-based, relies on a particular

[13] In Indonesia, farmer groups are officially recognized, and their formation requires the government's permission. More than one farmer group exists in one village, whereas only one farmer group is allowed in a hamlet. A hamlet is one administrative level below a village in rural areas, and one village can comprise more than one hamlet. This governance structure goes back to the Green Revolution period and applies to both conventional and organic agriculture.

epistemology (Konefal and Hatanaka 2011), qualified trainers are expected to have technical *and* administrative knowledge in organic agriculture. Although he did not use the term "model farmer," his description of his participation in the program seems to match that role. I often heard farmers and government officials mention the term when talking about strategies to promote organic agriculture.

By analyzing the training module of this program and farmers' experiences, I argue that the model farmer approach, to a certain extent, was implemented to address the aforementioned decontextualization issue. This is achieved through the selection criteria of organic trainers and a more-all-encompassing training that they received before starting to work in the respective areas. Eka described his training at the Agriculture Training Centre (BBPP), a training center for extension workers, lasted for more than one week. Based on his explanation and a copy of the training module that he gave me, the training covers various topics, including technical knowledge of organic agriculture, group dynamics, and institutions. For example, one PowerPoint presentation on "processing organic fertilizers," elaborates on procedures for making manure and compost, including a step-by-step guide and precise information on the period of fermentation (Sukmadjaja 2016). This presentation also provides tips on recognizing when manure is ready to use, based on its odor, texture, and color (ibid.). However, information on other inputs involving fermentation, for instance liquid fertilizers, is presented as a standardized procedure with exact quantities of ingredients, without including any perceptual information (ibid.). Therefore, this training module arguably demonstrates that agricultural knowledge is still predominantly disseminated as disembodied.

Nevertheless, I argue that the disembodied knowledge that Eka acquired from this training was transmitted and transformed into embodied knowledge to other farmers in FFS, where he demonstrated the preparation of organic inputs, and farmers had the opportunity for hands-on practice. This characteristic of organic agriculture suggests its reliance on farmers' embodied knowledge not only in the application, but also preparation of agricultural inputs. He was also responsible for motivating farmers throughout the whole five years of the implementation of the program. In this respect, he claimed, organic trainers are vital drivers of the implementation of this program.

During my stay with Ari's family, a member of the Fajar Mulia farmer group, in 2018, I found out that in contrast with the above IPM farmers who deem themselves as subordinate to extension workers, and yet more knowledgeable, the farmers Eka "trained" did not question the validity of his knowledge of organic agriculture as it was rooted in the same epistemology. His association with the government also gave him an authority to which farmers were receptive. During my stay at Wonokerto village, my host who was an elderly snake fruit farmer told me, "Eka is like a consultant who teaches snake fruit farmers in Sleman (a regency in Yogyakarta Special Region). He could come to this *dusun* (hamlet) because he was close to the *dinas*." While Ari was talking, he made a gesture of two fingers hooked together, a symbolic gesture that signals while Eka was a farmer and not a government official, he was closely connected with them. Eka's previous knowledge and experience on organic certification were valuable for farmers since organic-certified snake fruit is an export commodity that requires specific criteria in terms of the degree of ripeness, size, shape, all of which require specific cultivation techniques that differ from the conventional ones. Based on my observation of this farmer group and conversations with government officials of the department of agriculture of Sleman Regency during my stay at Ari's family in 2018 and another short visit in early 2019, these farmers did not encounter any severe farming problems in switching to the organic cultivation of snake fruits.

However, they struggled to comply with the administrative and record-keeping requirements of the organic certification process that decontextualizes their embodied knowledge. In December 2018, the farmer group was visited by inspectors from a certification agency as one of the final steps in awarding organic certification to the group. During this visit, the inspectors discovered record-keeping issues, such as unclear borders of farmers' gardens, lack of sale records, incomplete records of harvests, etc. Their final remark was farmers would have to "correct" these findings on an Excel sheet template that they provided for their snake fruit gardens to be certified as organic. Another common certification-related issue is the presence of banned substances at various concentration in farms and/or their vicinity, which often include farmers' houses. Therefore, organic agriculture relies on knowledge and technology to define, detect, and measure the presence of chemicals in organic commodities and agroecosystems. As Eka (and also other organic farmers) confessed, the creation of organic commodities through the certification process introduces new interdependency between agricultural research, agricultural commodities, and regulatory bodies, all of which I would suggest, underpins the creation of social categories (e.g. organic farmers and organic inspectors) with differentiated epistemic authority (Paxson 2013; Winickoff and Bushey 2010).

The above examples show that the radical simplification of alternative agriculture necessitates the transformation of agricultural knowledge from embodied to disembodied by decontextualizing the intuitive-subjective and perceptual characteristics of embodied agricultural knowledge. Furthermore, the bureaucratization of agricultural knowledge illustrates how regulatory institutions uphold differentiated authority and validity of this knowledge. In the case of IPM, influencing factors are cultural norms and the Presidential Decree No.3-1986 (President of the Republic of Indonesia 1986) that gave a mandate to government officials and entomologists, despite their minimum farming experience. Therefore, farmers accept experts' knowledge as authoritative, though not necessarily valid. In organic agriculture, certification mechanism introduces new sites and objects of contestation in alternative agriculture. Simultaneously, the recruitment of model farmers from the local area facilitated the intermediation of disembodied scientific knowledge taught to organic trainers and farmers' embodied knowledge.

Re-thinking Alternative Agriculture

This paper began with an ethnographic puzzle, that is a lack of language to bridge the dichotomy of science-culture and symbolic-material in contemporary agriculture. Through a dialogical analysis that adopts a post-structuralist approach to agricultural knowledge, I argue that these dichotomies are attributed to the hierarchization of heterogeneous knowledges in alternative agriculture for the past three decades. The continued hegemony of the reductionist and centralized government paradigm of the Green Revolution in alternative agriculture is reflected in its regulatory institutions that transform agricultural knowledge from embodied to disembodied. This shapes the interactions between extension workers, farmers, researchers, soil, plants, and insects in IPM and organic agriculture in Indonesia. In the end, multi-stakeholder participation, which is assumed to facilitate achieving the "best" solutions in technical and social terms, does not necessarily address inequalities in people's capacity to participate in knowledge-making (Pestre 2008). By relating the emergence of IPM with organic agriculture, the idea of model farmer could be read (to a certain extent) as an acknowledgement of the state on the importance farmers' embodied knowledge. This approach resonates with Andrew Flachs' (2017) discussion on "show farmers" whose "performance" to

practice new farming method like organic agriculture is contingent on the availability of incentives, such as economic rewards and social recognition. Given that agricultural programs are often planned for a short period and different government often has different agenda than their predecessors, to what extent model farmers are willing to make a long-term commitment?

By highlighting the dynamic processes of farmers' learning experience as they interact with other farmers, scientific institutions in the form of agricultural scientists, and the state in the form of extension workers and regulatory institutions, I demonstrate that the power of technoscientific regulatory institutions is not total. Through their embodied knowledge, farmers re-configure their encounters with scientific knowledge into sites of contestation where they reinterpret, question, and challenge established practices and institutions despite the continuous radical simplification of alternative agriculture. Therefore, my analysis complements previous studies on knowledge politics in agriculture and re-emphasizes the need to conceptualize alternative agriculture as temporally (re)produced through unequal epistemologies that structure interactions between social subjects and the environment.

The immediacy of embodied knowledge offers a different configuration of science and society in the politics of knowledge. During a conscious engagement in an instance, knowing how a material world works becomes inseparable from doing something to it. In this case, farmers' creativity and cultivated senses point to possibilities that elude those who understand agriculture only mentally. Therefore, embodied knowledge questions the notion of expertise in the technoscientific regimes of power. Acknowledging the risk of decontextualization where perceptual information is removed in knowledge classification, as the example of training module on organic agriculture and economic threshold illustrate, I suggest that farmers' capacity in influencing regulatory institutions needs to be understood in terms of knowledge intermediation. In this context, the vital roles of knowledge mediators, which can be taken by scientists and farmers, in bridging, but also transforming epistemological differences are crucial. It also implies greater involvement of farmers in contributing to regulatory institutions should receive proper compensation, financially and/or institutionally, for their labor and knowledge. Following Santos' (2018) call for the necessity of epistemological shift to recognize alternatives, farmers' embodied knowledge offers alternative thinking about the practices of alternative agriculture.

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