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Re-thinking greening TVET for traditional industries in Asia - the integration of a less-skilled labour force into green supply chains

Abstract

This article proposes a change of perspective on TVET in Asia in the context of the current discourse on sustainable development and the greening of economies in the region. It picks up on the debate around the greening of TVET, taking a closer look at the challenges faced by two countries: the Philippines and Vietnam. A necessary repositioning of TVET, and especially the greening of TVET, is suggested through an exploration of agriculture and manufacturing–two industries that traditionally account for most of the labour force in Asia and which, at the same time, are among the biggest environmental polluters. We highlight the need for non-formal, on-the-job training in the plant and in the field and for the inclusion of traditional industries, the main polluters, in the discussion on the greening of industries. A case is made for a practical, non-academic approach to training that closely links the demands of the market with the non-formal learning needs of ordinary workers and farmers. Based on best-practices, this article introduces the concept of an integrated service called "WeTrace" that contributes to the greening of TVET through a hands-on, field-based approach. The article provides an overview of practical experiences with the implementation of WeTrace and strategies for non-formal learning supported by smart technology, as applied to sustainable agriculture in the Philippines and Vietnam.

1   Introduction

Just before the 2015 United Nation Climate Change Conference in Paris, the headline of China Daily "*Asia faces catastrophic future unless leaders at Paris summit agree to cut emissions*" (China Daily 2015, 1) proclaimed a clear message emphasizing the urgent need for action. In acknowledging that urgency, this article examines some options for action in the greening of technical and vocational education and training (TVET) in Asia. Of note, UNESCO-UNVEVOC has been engaged in recent efforts to strengthen TVET in the Asiatic region, developing the skills and knowledge required for the transition to greener economies and societies (UNESCO 2015). It promises to be a long road, and not without obstacles along the way.

Despite the global discussions, the efforts of policy makers, the support of international development programs, the investment of international companies in select projects (such as renewables, effluent systems, or solid waste management), the fact remains that most young people employed in the developing and future markets of Asia are unskilled or under-quali-

fied and often without access to training. How can we integrate that major pool of labour force for the challenge of greening TVET on a larger scale? This article not only tackles this issue, but offers a different perspective on the greening of TVET by highlighting the approaches of industrial sectors which often appear resistant to change. The targets formulated in the UN's Sustainable Development Goals (SDGs) (UN 2015) should not be limited to the greening of formal credentials in technical education. Perhaps even more important is the embedding of green skills across all industrial processes through strategies for life-long or continuous learning. The development of a robust TVET system in Asia is still ongoing, but driven by global needs there is increasing pressure to address training for sustainable development that includes not a minority, but the majority of those involved in economic production.

2   Skills and TVET for sustainable development

2.1   Green economy, skills development and TVET

The debate on greening TVET stems from the sustainable development agenda and is linked with the concept of a "green economy". Whereas there are many proposed definitions for the term green economy, they all emphasize responsible economic practices that support further economic growth and positive social development, while valuing and handling natural resources responsibly.

Since 2008 the United Nations Environment Programme (UNEP) has supported the agenda of a green economy. Its Green Economy Initiative defines a:

"[…] green economy as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive.

Practically speaking, a green economy is one whose growth in income and employment is driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services. These investments need to be catalysed and supported by targeted public expenditure, policy reforms and regulation changes."(UNEP 2015)

The TVET sector has the capacity to leverage employment opportunities and economic productivity, competitiveness and quality as well as meeting the challenges of economic change and development (Montague 2013, 210). According to the UNEP characteristics of a green economy, a TVET system should incorporate environmental protection as well as resource efficiency, risk management and social inclusion. As the Asian economies are still striving for stable development and increased industrialisation, the adoption of a green economy and green TVET-systems must be based on the principle of *"growing cleaner without*

growing slower" (Jagannathan 2013, 266). Such changes have unprecedented consequences for teacher training, curricula and training methods.

Notable milestones in the discourse on sustainable development, the greening of the economy and the implications for TVET include the Brundtland Report (laying the foundations of the sustainable development era), the UN Agenda 21 and the Rio+ Conferences, and the decision of the General Assembly of the United Nations to declare the years 2005 - 2014 as the UN Decade for Sustainable Development (BMZ 2013, 28). UNESCO and UNEVOC, the United Nations agencies responsible for setting a global direction and facilitating consensus for education and training, stated in their 2004 Bonn declaration: "*since education is considered the key to effective development strategies, technical and vocational education and training (TVET) must be the master key that can alleviate poverty, promote peace, conserve the environment, improve the quality of life for all and help achieve sustainable development.*" (UNESCO/UNEVOC 2004, 1)

This statement pointedly emphasises the significance of quality technical and vocational education and training for individuals, businesses and societies. A well-planned and well-implemented TVET system extends its influence into the social, economic and the ecological spheres. As such, the distinction that is often made between education and TVET for sustainable development (ESD/TVETSD) on the one hand, and green education or green TVET on the other hand, is considered an artificial one. Both concepts serve the higher purpose of a more sustainable future. Hence we use the terms interchangeably, as does the TVET expert and Head of the UNESCO-UNEVOC International Centre for Technical and Vocational Education and Training Shyamal Majumdar (Majumdar 2010).

2.2   Skill shortages versus need for green skills in TVET

Asian countries, especially those in Southeast Asia, with highly dynamic economies, are being challenged in their position as global powerhouses of production by the practical implications of greening those economies. For many years, massive expansion and exploitation of natural resources have improved their economic performance. However, now they, like the rest of the world, are facing the consequences of pollution, production methods that pose health hazards and ecological harm, and unrestrained growth (JFien et al. 2013, 255f.). They no longer just need to provide the necessary manpower to meet production demands of a globalised market, but also need to catch up on quality requirements, production standards and legal compliance frameworks that are increasingly reforming the exchange of goods and services. They are also under pressure to prepare themselves for the risks of climate change as well as develop strategies for more resilient economic and social systems. In order to accommodate all this, these countries need to redefine and rework their educational systems. This especially applies to their technical and vocational education and training, if they want to retain and improve their competitive position in the global market and contribute to a greener economy.

The movement towards a greener economy will undoubtedly change the labour market. While further advances in green technology and efficient automation, or the elimination of high-emission/pollution industries may result in the demise of many jobs and professions, other jobs will need to be modified. Existing jobs may need a broader set of sustainability and greener skills and practices, or require 'up-skilling'. New jobs may need to be created to achieve a greening of societies and industry sectors (Majumdar 2011).

In this paper, we adopt a holistic definition of green skills: "*What is meant here are skills, abilities and the willingness to recognise and to assess the direct and indirect effects of occupational activities on the environment as well as on the living and working conditions of other human beings (of present and future generations) and to avoid negative effects as much as possible.*" (BMZ 2013, 28)

Many publications on the greening of TVET focus on qualifications that need to be acquired through academic careers, higher education in the engineering disciplines, or jobs that require so-called "high-skilled" workers with several years of intensive training. This focus aligns with the general current high cultural and societal value placed on tertiary education as compared to vocational education or apprenticeship. We suggest that the focus be shifted towards a broader and more inclusive definition of global labour. The TVET community needs to promote awareness of the demand for sustainability and green skills, and not only in new professions like the bio-energy sector. In every industry or production cycle, natural resources and chemical inputs are used, and emissions and wastes generated—in growing vegetables, manufacturing shoes, or construction. Each worker engaged in these value chains, regardless of their educational level, has an impact on the production and consumption cycle. High-level policies, strategic plans, or innovative technologies will not have the impact hoped for, unless the workers on the ground have acquired the necessary green skills to put these ideas into practice. Without this capacity for change, the skills shortages of today become the skills gaps of tomorrow (Montague 2013, 209f; 219f)

This article focuses on the labour force in Vietnam and the Philippines, which consists to a large extent of workers in manufacturing and agriculture (PH - agriculture: 30%, industry: 16%; VN - agriculture: 48%, industry: 21% (CIA 2015)). Only a small percentage of these workers have received comprehensive formal education and training. Most, are so-called unskilled and semi-skilled workers, or workers who achieved their skills through informal or non-formal education and training while on the job or outside the workplace (Martinez-Fernandez et al 2013, 166f). These people are also among those who most feel the negative impacts of unsustainable production practices. In their workplace they might be confronted with the overuse of chemicals jeopardising their health, or on their farms and fields their livelihood is threatened by soil erosion or recurring floods.

For these target groups the most likely starting point in skill transformation will be enhancing and expanding their existing work skills through knowledge transfer and practical training. This might focus on new work routines that have a positive effect on their livelihood and, on the larger scale, contribute to a green economy and sustainable development. Although this

approach may seem very basic or detail-oriented, small changes in everyday work practice for all employees in a company, or on a farm, will cumulatively build towards a whole new core of sustainability practices, not only in individual businesses, but in the supply chains fed by these workers and producers through their labour. These new capabilities will, for example, entail different practices in the handling and use of chemicals, different routines for waste management or increased attention to safety and health protection in daily work activities. In agriculture, for example, this might also include adjusted protocols for soil protection, or the choice of seeds and crops that are more resilient to changing climatic conditions. For each area of skill development, the initial first step towards long-term greening is always to first raise awareness as to where existing practices intersect with matters of sustainable production and consumption, as well as building a sense of ethical behaviour and responsibility for one's own environment and that of the community. Then it is possible to build on this and train for technical skills in the actual production process.

To summarise:

- TVET is key to implementing a global greening concept based on national strategies for industry

- New green and greener skills are urgently needed for both modern technical and traditional sectors

- The goals are ambitious, but there are significant opportunities for the personal and professional development of the individual in the workforce.

3 Challenges of greening TVET in Southeast Asia

3.1 Background for greening TVET in the Philippines and Vietnam

While the global community is beginning to realise the need for green vocational skills and greener TVET systems and curricula, these systems and their affiliated institutions face problems regarding the quality, financing and accessibility of skill development for all citizens. One challenge is that of incorporating new green educational goals into already strained education systems (BMZ 2013, 30). This may require redefinition and augmentation of existing curricula and qualifications; creating extended curricula or developing completely new ones for existing jobs, and even defining new vocational qualifications for new green jobs created as part of a modernisation strategy for a specific industry, or the economy at large. These challenges apply equally to all the diverse forms of vocational education and training including formal TVET schools, technical colleges, training in the workplace, apprenticeships and other informal and non-formal settings (Maclean et al. 2013, 5ff.).

The challenge is how best to align the required changes and developments in TVET with national sustainability strategies. The authors focus on the Philippines and Vietnam as case studies. Each country has adopted its own policies and strategies; having committed themselves more than 20 years ago to the UN Agenda 21. They have also each set their own strat-

egy for a national path towards sustainable development. Vietnam adopted its newest "National Green Growth Strategy" in 2012. The Philippines addressed their plans for a greener future in their 1990 "Philippines strategy for sustainable development (PSSD)" supplemented in 2004 with their "Enhanced Philippine Agenda 21 (EPA)". Although these, and many more policies and agendas, are in place regarding sustainability in both national development plans and economic strategies, the current state of the environment, economy and education of the countries does not reflect these theoretical and strategic inputs. Both countries are experiencing significant problems regarding environmental issues (e.g., air pollution in the megacity Manila, water contamination in the Mekong delta, landslides, coastal erosion and floods). As compared to the Philippines, Vietnam has been on a more steady path to growth and a stable economic outlook, but both countries still face major challenges like inflation, underemployment and comparatively low gross national income per capita (CIA 2015; UNDP 2014). To tackle these challenges, section 4 of this article proposes a "walk the talk" approach for greening that targets the unskilled and semi-skilled labour forces in the main production sectors, agriculture and manufacturing, in both Asian countries.

3.2 The interrelationship between greening TVET and the economy in Vietnam and the Philippines

The rapid development of economies in the Association of Southeast Asian Nations (ASEAN) region has resulted in the necessity of permanent, economic, structural change and a great need for a highly-qualified skilled labour force. The association of these countries into a single common market not only affects more than 600 million people, it is one of the most outstanding and challenging events in the history of the region. The ASEAN motto "One Vision, One Caring and One Sharing Community" reflects the willingness of this community of states to co-operate politically and economically. One of the three pillars of ASEAN is the ASEAN Economic Community (AEC), the goal of which is to transform ASEAN into a single market and single production base by the end of 2015. One of its main objectives is to increase the mobility of skilled labour in the region by co-operating in three main areas: a) the recognition of professional qualifications, b) regional human resource development and capacity building, and c) the integration of industries across the region to promote regional sourcing (Kunz 2014).

At the plant and at the field level, there have also been significant changes. In the last two decades Vietnam has achieved remarkable poverty reduction and economic growth mainly through mass production industries such as apparel, shoes, and assembly of appliances—industries that require a lower-skilled labour force. Now facing the transformation from mass, to quality production, Vietnam claims a shortage in skilled labour, mainly in technical jobs. Only 19% of workers have received any form of job training, only 6% have an apprenticeship of at least two years. Almost 24 million workers (around 80% of the workforce) are low-skilled or unskilled in Vietnam. Seven million people - more than 20% of the economically active population - work in the original green sector, agriculture (ADB 2014).

Food production is both a global concern as well as a global, interconnected market. By 2050 the world needs not only to produce 40 - 70% more food on the same surface of agricultural land, but adapt to the additional threat of climate change. The Philippines are already one of the most affected countries in this regard. In addition, the nation has no functional strategy on food security as compared to Vietnam and other ASEAN countries. Up to 40% of the economic population works in this primary sector which contributes only 10% to the national GDP. Small landholders farm an average of one hectare. In Europe, where only 3% work in this sector, farmers cultivate an average of 26 hectares.

Since the 1990s the Philippine archipelago has seen significant growth in the service sector. In addition it has approximately 10 million Filipinos registered as overseas workers. Most of them are skilled, even having tertiary education, but cannot find job opportunities in the Philippines. This brain-drain (Alburo & Abella 2002) is related less to the so-called phenomena of over-population, and more to political and economic strategies resulting in limited work opportunities.

So how do these scenarios affect TVET in the ASEAN region? Of course, TVET plays an important role in enabling regional socio-economic development. Countries are in the process of strengthening and reforming TVET to meet the demands of economic growth and competitiveness, as well as societal change. Policy development is one critical aspect in repositioning TVET and further developing its responsiveness to the greening agenda. However, it is difficult to compare TVET systems across jurisdictions as shown in the example of Vietnam and the Philippines. Not only are there different political agendas, but the collection of empirical evidence for comparative analysis is difficult. As a result, it is not easy to formulate a common strategy and vision among ASEAN countries for the reform of TVET.

For example, it has often been questioned as to whether it is easier to establish a new green job profile, such as for solar, wind or biomass technology, rather than greening existing curricula, such as that for agriculture or the textile industry. Given the outcomes of the climate change summit in Paris 2015, there is no doubt that clean/renewable energy topics are a matter of some urgency and need to be introduced into current TVET systems. To assist in this process, international organisations such as UNESCO, UNEVOC and other development agencies are developing strategies to help build awareness and capacity in TVET. As a result, Vietnam has started to invest in new technologies and is collaborating with international companies to jointly introduce green technologies to the market. At the same time, government training institutions are adopting new greener technologies and a focus on science, technology, engineering and mathematics (STEM) as a foundation for technologies is helping to pave the way for expansion in the technical green sector. In contrast, in the Philippines, the implementation of new green technologies is limited by the poor quality of training facilities and weak labour market intelligence. Furthermore, the low quality and lack of relevance of TVET, particularly for school-based and privately-run programmes (UNEVOC 2014), is a limiting factor. Thus between the two countries, TVET in Vietnam is viewed as more credible due to its investment in the engineering of technical products. In contrast, the strong service sector in the Philippines, including the booming ICT industry, has mostly recruited graduates

from tertiary education. There are certain small initiatives in green technology and related qualifications, but these activities make up only a small percentage of TVET activity and niche markets.

Different approaches to greening are also apparent in the context of environmental compliance in mass production, such as the apparel or the shoe sector, as well as in the movement to sustainable agriculture. As a result of the shift of the Chinese apparel industry to Vietnam, the country has started to review its environmental policy in order to remain competitive (Greer 2014). Textile dyeing and finishing have a significant environmental impact. The Philippines has only a small number of apparel and shoe producers today as compared to the boom in the eighties and nineties when China took over with its then, low wage policies. Of necessity, the demand in global trade for cleaner production is rising, but both industry and trade have been slow to respond, and for almost two decades practices have been found wanting. Today, greener production practices are becoming a competitive advantage and need to be embedded in TVET as a cross-sectoral subject. The question for low and unskilled workers in the ASEAN region is: how to best train them? Outside or inside the TVET system?

That results into the following findings:

- There is a common vision for the greening of TVET in ASEAN countries, but the respective implementation strategies differ.

- The level of greening in TVET depends on the particular economic dynamics and structure in a given jurisdiction.

- The greening process in farming and the textile and shoe industry is still marginalized, despite the fact that it is the source of livelihood for the majority of the population.

4   The challenge of green skill development in ASEAN

Criticism of the TVET sector by industry is not uncommon. Training centres are slow to respond to new requirements and higher standards for training and education. Communication and collaboration between the TVET sector and industry needs to improve significantly to resolve these differences. As stated, introducing new green technical innovation needs substantively modified, or new curricula and this adaptation will be a challenge for TVET.

As noted, the majority of workers and farmers who still dominate the labour market in total figures work in industries characterised by low technical skill and/or low wages. Both the manufacturing and agriculture sectors have a heavy environmental impact through pollution of eco-systems, and training and education to mitigate these impacts is still limited. Despite the introduction of numerous new standards and initiatives through global trade and industry, as well as the impetus of Rio in 1992 and cumulated knowledge around climate change, real progress in moving towards cleaner production processes has already taken too long. The external pressure to implement best practices is still insufficient to effect real change.

Yet small, incremental changes are possible through education reform. Environmental and social compliance for the apparel industry does not require scientific knowledge for workers, but rather a systematic approach to implementing new standards in every-day practice. In this process, non-formal education is often neglected; however, it is appropriate in meeting the identified training needs of workers and farmers. Workers need to be trained on-the-job in their own working environment following a methodological-didactical approach that best relates to their learning abilities as well as addressing the issues of access and costs. The learning process must permeate the entire value chain in order to build understanding of the interdependencies and causality of different actions and environmental impacts. It is not only automation and internalization of manufacturing procedures that need to be addressed, but also the move towards full traceability, in order to verify compliance with environmental regulations at every step in the production process. Despite Western-driven trade and industry groups promoting their 'best' practices, the highly industrialised countries have not followed up on their promise of greener and more transparent production. Asia has the opportunity of not only avoiding their mistakes, but modelling 'next' practices after the environmental depletion of the last twenty years.

At that state of discussion it makes sense to review the historic dimension of greening. The Western industrialised world has developed a lot of best practice green solutions and renewable energy technology in the last two decades, but it has also not learned from its failures. In 1972 the Club of Rome expressed in its publication "The limits of growth" that human activities could grow large enough to alter basic natural processes of the globe. Today we routinely observe, acknowledge, and discuss the ozone hole, destruction of marine fish stocks, climate change and other global problems (Meadow 2004). After more than 40 years, the West has to conclude that the prediction of 1972 was correct. Given this, there is no alternative - neither in Asia, nor in Europe, nor America - to facilitating green and sustainable development as a holistic concept. Innovative forms of TVET could be the vehicle for knowledge transfer that contributes to a better future.

5 Best practice example in agriculture

The German company, Knowledge Intelligence Applications GmbH (KIAG), has started to share its industry experience to the benefit of the agriculture and textile industries in emerging and developing markets. With the support of German public-private partnerships including KfW/DEG, sequa and KIAG, the WeTrace initiative (www.wetrace.org) is presented here as a best practice solution to demonstrate how smart technology can be linked with non-formal education and training; in this instance, for innovation in agriculture. Two case studies are explored here that illustrate the comparative differences between two ASEAN countries through documentation of their individual strategies and intentions in implementing policies for green agriculture.

Everybody depends on agriculture. It feeds our entire population and produces fibre for clothing, feed for livestock and bioenergy. Hence it is not surprising that in Germany alone there

are nine established training occupations that require substantial TVET for workers in this area. In the developing world, agriculture contributes significantly to the GDP, leads the way to poverty reduction and accounts for the majority of employment opportunities, especially for women. Agriculture also has one of the highest potentials for reducing carbon emissions and helping vulnerable people adapt to climate change. (Farming First, 2015). Countries like the Philippines and Vietnam have to improve their agricultural production and gain more value from it. Food security and food safety are major issues. Global estimates suggest 31 main hazards were responsible for 600 million foodborne illnesses and 420,000 deaths in 2010 (WHO 2015); and the majority of the global population lives in Asia.

Perceptions of food production differ in the two countries. Vietnam is keen on producing its own food, and developing export markets. In the Philippines, the Retail Association claims that up to 75% of fresh food sold in retail is imported. Quality is mostly indicated by price and appearance. Good Agricultural Practices (GAP), as a methodological process to produce safe and healthy crops, is in its infancy. Although the Philippine Department of Agriculture has started to review organic food production, there is, as yet, no certification and independent testing body to verify organic status. In 2006, ASEAN GAP was disseminated across all ASEAN countries and was established as an acknowledged common standard with minor national differences. Further developments to improve the standard for food quality are ongoing. In 2014, the first small-landholders in the Philippines were certified by the Bureau of Agriculture and Food Production Standards (BAPFS).

Vietnam introduced its GAP version under Viet GAP first in 2008. Subsequently, thousands of farmers countrywide are now Viet GAP certified. GLOBAL G.A.P., as well as European organic standards, have also successfully been introduced in the country. There is still room for improvement, but the necessity of improving agriculture through sustainable practices, for instance by minimizing chemical inputs such as fertilizer, or pesticide use through methods of integrated pest management, appear to be progressing more rapidly than in the Philippines.

In the Philippines, technical training and education in agriculture is a field divided between the Department of Agriculture (DA) and the Technical Education and Skills Development Authority (TESDA). There is no comprehensive or modular training covering the whole spectrum of farming. Small-landholders' activities to improve farming on a more sustainable level are mostly supported by NGO initiatives.

In 2008, the Government of Vietnam endorsed the introduction of a standards-based approach to TVET in order to improve the quality and relevance of its vocational training provision for rural workers. The aim of the Rural Training Program *'is to improve the quality of rural labour in meeting the requirements of industrialization and modernization of the agriculture sector and rural areas.''* (ADB 2014, 51). In shifting vocational training for rural workers from a supply-driven approach to a demand-driven approach, the program seeks to provide vocational training for approximately one million rural workers per year, including training for 100,000 village civil servants. It also aims to improve the quality and efficiency of voca-

tional training so as to generate employment, increase incomes, contribute to restructuring the rural economy and labour force, and support the industrialization and modernization of agriculture. The program is not without its critics. The Asian Development Bank (ADB) claims that there has been insufficient analysis of the training needs; resulting in lack of clarity of purpose and a weak business case. (ADB 2014).

The training content of the Vietnamese TVET system includes technical objectives, but does not extend to the complexity of sustainable practices in the value chain. This could be easily resolved. The GAP standard in both the Philippines and Vietnam for numerous crops is clearly structured. It could be adapted and included in the Vietnamese curriculum if the relevant institutions – Ministry of Labour, Invalids and Social Affairs (MoLISA) and its General Directorate for Vocational Training (GDVT) – would opt to close this industry-market divide. This also applies to sustainable and organic practices that are increasingly in demand in the metropolitan areas of Ho Chi Minh City and Hanoi.

The WeTrace initiative has adopted the approach described above for the Philippines and Vietnam, despite structural differences in the industry between the two countries. Production follows the same procedures and requirements within the different value chains. The development process for the integrated service consists of the five pillars described below that have been built on experiences in the field and have proven to be an effective foundation for greening and learning in agriculture.

5.1   Pillar one: Standard analysis and market requirements

The WeTrace process begins with a standard comparison of national and international requirements across the entire agricultural spectrum. This also includes a review of the TVET agricultural curricula in the respective countries. As well, organic practices or fair trade protocols, are integrated, if the market requires this. After an in-depth analysis of practices with local experts and farmers, the body of knowledge   is systematically organised in parallel with the supply chain – from 'field to fork'. Translation of the standards into the local language is essential if there is to be a correlation with the working reality in a specific area.

5.2   Pillar two: Supply chain analysis with farmers

By transecting the defined path of the supply chain all players (e.g., for agriculture: input supplier, farmer, rural worker, logistics, collection centre, and buyer) are engaged in the participatory approach to process review and skill development. With the aid of questionnaires, all steps within the supply chain are reviewed and discussed in order to identify critical weak points such as selection of growing conditions, quality inputs, pest management and post-harvest procedures. For the farmers, the process helps to facilitate a better understanding of their own unique environment, as well as the development of learning strategies that address the weak points in their systems. Using a step-by-step process, and the use of custom learning materials, farmers develop skills that enable them to contribute to making the supply chain

more efficient and a curriculum emerges that is shaped by the working reality of the farmer-participants.

5.3   Pillar three: Web-based traceability tool

Access to smart phones and IT is very common among farmers in the ASEAN region. Capitalising on this infrastructure, WeTrace has developed a traceability tool (including an offline and online version) which covers the whole supply chain. Similar to the supply chain analysis, the farmers participate actively in the development process as they have to operate the traceability tool. Farmers have their own farm book where all their actions can be documented. Symbols guide farmers, not only while documenting actions, but also allowing them to assess their own performance. The tool also provides a database for quantitative data—the purchase and use of inputs, master data of the farm, climate data to assess changes related to natural conditions, etc. Groups of farmers or cooperatives producing for a certain buyer/market have the opportunity to forward all their data to a central hub, in order to guide distribution and sales, as well as to provide regular updates to the quality assurance processes that promote sustainable, safe and healthy fresh food produce. The goal is to implement an effective system for a closed supply chain with assurances that both market quality and quantity are in compliance with environmental standards.

5.4   Pillar four: Blended learning

IT programs provide tailor-made tools to train people and help them internalise the concepts of quality and, in particular, green quality. However, they cannot be the only means of learning. As already mentioned, a good curriculum is fundamental to the learning process. Using established curriculum, so-called compliance officers are trained to assist farmers in their daily routine. The approach is based on a monitoring/advisory model, extending assistance to farmers, rather than directing them. Farmers receive feedback on the effectiveness of the corrective actions used to improve their current practices. By working across the entire value chain, it's also possible to communicate further findings effectively such as problems in market relations or the need for better compliance with occupational health and safety requirements. Agricultural markets are fast changing and the training must respond accordingly as part of a continuous cycle. Today the modern farmer is not only a grower. He is in business and needs to protect and sustain his main capital: the environment. Alternating training between field assistance and (open source) software applications through smart technologies is helping to build sustainable farming practices. Based on findings that a farmer in Vietnam learns differently from his Philippine counterpart, KIAG has also started to modify the methodological-didactical approach; working with the faculty of Education of the Technical University of Dortmund/Germany. Non-formal learning is thus considered as a continuous cycle that requires the involvement of multiple stakeholders with differing perspectives.

5.5   Pillar five: Business Intelligence for complex monitoring

WeTrace has been in use since 2014 as a training and performance tool and while farmers are excited to use modern, smart technology it has also changed the way they do business. They can now input both qualitative and quantitative data into their smartphones and tablets recording their farming activities. These data serve as the basis for providing them with business intelligence and its associated benefits.

Business Intelligence (BI) can be defined as a set of techniques and tools for the transformation of raw data into meaningful and useful information for business analysis. Buyers receive the data they need to set their orders; they value the system's inherent quality assurances and trust the business relationship with the farmer. This results in a stronger position for the farmers, enabling them to not only set their own prices, but also protecting them from daily price fluctuations driven by buyers. These significant incentives are what has drawn small-landholders to work with the WeTrace system. Furthermore, development programs maintained by government and non-government organisations can also be better monitored by interpreting and analysing the performance data.

In comparison, the Vietnamese market is much more advanced. Farmers produce larger quantities than in the Philippines. In addition, they are better organized in the context of producer cooperatives, contract farming, and the newest trends of closed supply chains owned and managed by retailers. With more players, larger areas under cultivation and obvious distinct regional differences, the option of comparing correlations of production data through use of WeTrace is valuable. Quality seeds can be better selected to correspond with specific soil characteristics; irrigation systems can be better optimised, and post-harvest procedures can be redesigned to find efficiencies. The effects of crop rotation and shifting cultivation as options to maintain soil fertility, as well as soil protection through use of cover crops can be better measured and reported. In addition, tracking laboratory results can serve to improve sustainable and organic practice. BI is under continuous development and promises a local, regional, and national overview for screening and monitoring rural development in the light of sustainable practices. In short, WeTrace is a tool which is gaining traction in the agricultural sector, with its capacity to not only stimulate and support the greening of production practices, but because of its capacity to provide continuous support via smart technologies to low-skilled or unskilled workers.

The five pillars of WeTrace are not only useful for agriculture, but also relevant for workers in manufacturing/mass-production. As with the agricultural sector, there needs to be a way of embedding green and social subjects across the training system and in particular, in continuous or lifelong learning. Smart technologies may be particularly useful in supporting industries that need to adapt even minimal standards for sustainable production. They can help to close the communication and information gap through innovative forms of training and delivery. While face-to-face learning, with its strong social component, will remain an important element in training programs, the WeTrace approach, which focuses on non-formal education and training, could be an important tool in adopting smart solutions to make industrial pro-

cesses more transparent and greener. It might take some time for TVET partners to adopt this new technology for training and education. At least farmers and workers are open to innovation.

6 Conclusions

Given the interrelationship between the greening of TVET and market demand for greener products and services, the function of TVET should not be limited to the transfer of technical knowledge for new job profiles in areas such as renewable energy. TVET should also be a contributor to strategies that promote the integration of principles of sustainable development into life-long learning. This approach is particularly important for those who have little or no access to a laddered educational system. Green/sustainable development is a cross-sectoral issue of growing significance in the world of work (especially in agriculture and labour-intensive manufacturing). It will take time for TVET and the entire educational system to more effectively match the specific demands of traditional and modern industries as they negotiate the greening process. Nevertheless climate change requires immediate action.

The political dimension of TVET can be seen in our comparison of the Vietnamese and Philippine models. Vietnam, as a country that focuses on its industrial production, has already achieved remarkable outcomes in graduate performance, although TVET as a concept is relatively young. Nevertheless, current skills shortages may need to be addressed differently. In order to ensure critical skills gaps are met, a combined approach of TVET and life-long-learning might be the most effective means of greening traditional industries.

An association like ASEAN has a common vison and policy, but the greening of TVET will likely lead to a diversity of approaches across jurisdictions. Common guiding principles are needed in order to successfully address technical issues such as teacher training, curriculum development and training delivery.

Asian economies need to assess their specific capabilities in order to minimize the environmental impact of production processes. They must be willing to make compromises in order to assure a better, sustainable future, recognising that the concept of unlimited economic growth does, indeed seem to have run its course. New tools such as industry standards have been developed in order to support and promote sustainable production—standards that have been designed for people and not for factories and machinery. The idea of transparency within the supply chain is not without challenges, but one not insurmountable in light of new approaches to knowledge transfer and learning in the context of sustainable development. High-tech industries are already speaking of the next industrial age—industry 4.0 and smart solutions can be adapted to any industry if the right values are assigned to both the environment and to people. This is an opportunity to legitimise and promote non-formal learning using technology that will be soon accessible to the majority of people in Asia. As a global community we need to reassess our perspectives on traditional education – it has enormous capacity for leveraging change. Educational reform may be the most important tool in the future of greening and sustainability.

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