vegIMPACT: Knowledge Transfer

Improving vegetable production by smallholder farmers in Indonesia

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vegIMPACT

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Preface

This study of the programme 'vegIMPACT' provides detailed insight into the effect of wide-scale trainings of vegetable farmers across Indonesia on the production practices and economic performance of these farmers.

The vegIMPACT programme, shorthand for 'vegetable production and marketing with impact', aims to improve vegetable production and marketing of small farmers in Indonesia. As such, its objective is to contribute to increased food security and private sector development in Indonesia. The programme is financed by the Dutch government and is carried out by Wageningen University and Research (WUR) together with the Indonesian Vegetable Research Institute (IVEGRI), Fresh Dynamics Asia and national and international companies in vegetable production and marketing (2012-2017).

VegIMPACT consists of different intervention strategies and the intervention assessed in this study is the Work Package *Knowledge Transfer*. Many smallholder farmers were trained in a close partnership with East West Seed Indonesia (Ewindo, in Indonesia known as the brand name *Panah Merah*) and its Corporate Social Responsibility foundation YBTS (*Yayasan Bina Tani Sejahtera*) in the period 2014 till 2017. More than 10,000 farmers received trainings on Good Agricultural Practices (GAP) consisting of theoretical information, demonstration of production techniques as well opportunities for farmers to practice new production techniques and acquire new practical skills.

As part of the overall vegIMPACT programme the Work Package Monitoring and Evaluation (M&E) focused specifically on the results of the training activities. Based on a broadly accepted conceptual framework, M&E assesses whether training activities in vegIMPACT have changed the behaviour of trained farmers towards good agricultural practices and reinforced the associated performance or programme indicators.

This report presents the results which were gathered through a mixed-method approach. The evidence-based results of this study enable to reflect on the applied method of Knowledge Transfer as an approach for improving the vegetable production among smallholder farmers in Indonesia. It gives insights into the effects of the trainings on changing production practices and economic performance of the trained farmers and into whether programme objectives set at the start of the vegIMPACT programme have been achieved. In addition, it provides food for thought for practitioners, policymakers and scientists to uplift the discussion on the pros and cons of the applied training intervention providing insights into barriers and enablers for success.

We kindly thank Ewindo, the staff of the vegIMPACT local support office in Jakarta and the cooperation of the farmers in the research areas. We hope that this report provides a relevant reference for future design and out roll of knowledge transfer programmes among smallholder farmers.

Wageningen, November 2017

Prof.dr.ir. J.G.A.J. (Jack) van der Vorst
General Director Social Sciences Group
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Summary

Low food and nutrition security in Indonesia

Indonesia is a lower-middle income country and is the largest economy in Southeast Asia. Rapid economic growth over the past ten years, coupled with significant government investments in social development, transformed the lives of millions of people. However, the benefits of economic growth are not shared equally by all: Access to food is uneven and the quality of diet can and should be improved with more products of high nutritional value. The World Food Programme (WFP) indicates that this is heavily influenced by factors like poverty and lack of infrastructure. High food prices compound the situation and millions of people are unable to meet their dietary requirements. Poorly varied diets, based mainly on rice, mean that the country is faced with malnutrition, stunting and obesity.

Potential of horticulture and improvement of agricultural sector

The horticulture sector can contribute to this nutrition-related challenge by providing more diverse and more healthy food. In addition, the production of high value crops like vegetables could contribute to an increased income of rural households. The agricultural sector of Indonesia is underperforming because of a low investment in agriculture and R&D, but also poor logistics and lack of national and international investments in agriculture play a role. Most farmers do not apply state-of-the-art technology, resulting in low productivity, high costs of production and poor quality of produce. The link between production and markets/consumers should be enhanced through better targeting of production to consumer demands. Most of the agricultural produce, also commodities that are exported, is not processed. There are ample opportunities for value adding in the agricultural commodity chains.

Urgent need for improving knowledge of good agricultural practices

The vegIMPACT programme, short for 'vegetable production and marketing with impact', was designed in this context of low food and nutrition security, rural poverty and the potential in the agricultural sector. The focus of vegIMPACT is horticulture and good agricultural practices to respond to the urgent need for improved knowledge on good agricultural practices and market access. The programme is financed by the Dutch government and is carried out by Wageningen University and Research Centre (WUR) together with local partners and national and international companies in vegetable production and marketing (2012-2017).

Key elements of vegIMPACT are practical training and capacity building of smallholder farmers concerning good agricultural practices and marketing

VegIMPACT consists of different intervention strategies. Many of them focus on practical training and capacity building of farmers and other stakeholders in vegetable chains. Also in the Work Package Knowledge Transfer (KT), many smallholder farmers were trained in a close partnership with the company East West Seed Indonesia (Ewindo), its foundation YBTS (*Yayasan Bina Tani Sejahtera)* and the Indonesian Vegetable Research Institute (IVEGRI). The intervention is based on the Theory of Change (ToC) of WP KT (Figure S.1 and Appendix 1a). The ToC shows how the different activities contribute to and result in the planned outputs, outcomes and impact.

The programme promotes good agricultural practices, the use of good quality seed and crop planting schedules and trains farmers in collective action, market access and contractual arrangements. All activities are based on the assumptions that the sharing of knowledge on improved practices (knowledge and awareness) will result in improved practices. To capture this we applied a survey design based on the KAP model (Knowledge – Attitude – Practices) (MdM 2011, WHO 2008) to collect information on what is known, believed and done in relation to the topics of Knowledge Transfer (KT).

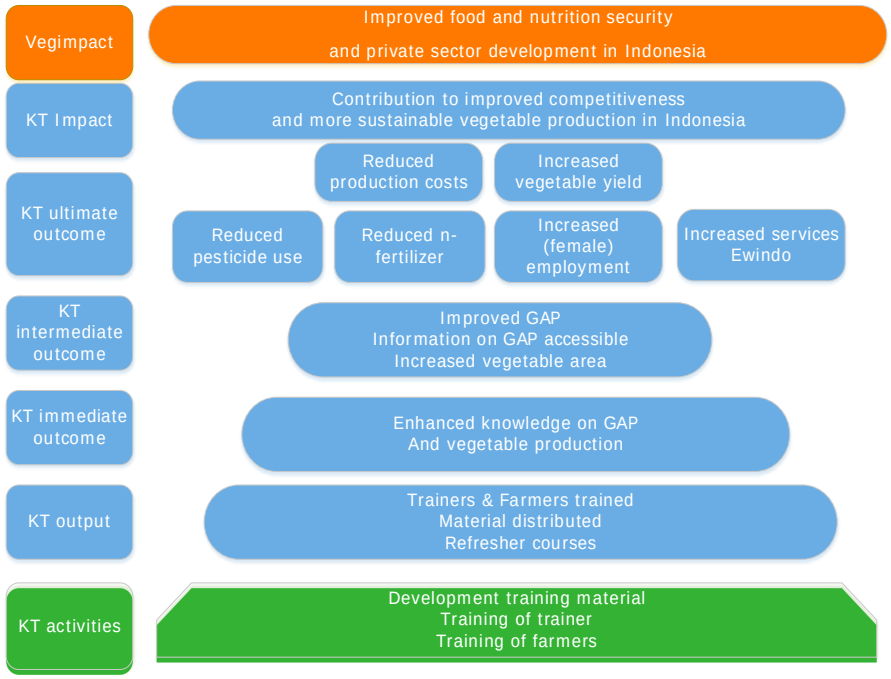

Figure S.1 Theory of Change of Knowledge Transfer

Performance indicators were formulated based on the ToC

A number of performance indicators have been identified at programme development in collaboration with the client, the Ministry of Foreign Affairs in the Netherlands. The evaluation of the Work Package KT is done using the following performance indicators (ultimate outcome indicators in the ToC):

1. Increased vegetable area
2. Increased vegetable productivity
3. Reduced pesticide use per unit product
4. Reduced nitrogen fertiliser use per unit product
5. Reduced production costs per hectare
6. Reduced occupational health problems and risk

Delivering solid proof of the programmes' effectiveness is important

Within the WP Monitoring and Evaluation, Wageningen Economic Research conducted the evaluation of KT. Based on a broadly accepted conceptual framework, the evaluation team assessed whether training activities in vegIMPACT and WP KT have changed the behaviour of trained farmers on GAP and influenced a number of selected ultimate outcome indicators (i.e. yields, production costs). This report delivers solid proof of the effectiveness of KT by assessing (changes in) the performance indicators focusing on the three crops of the trainings: tomato, hot pepper and cucumber. In addition, it provides important insights for the discussion on explaining effects, the limitations of the intervention logic and contextual barriers and enablers.

Mixed quantitative and qualitative methods applied

In the evaluation, a mixed-method approach is applied: surveys 'before' and 'after' the intervention are used in combination with focus group discussions (FGDs) with farmer participants and interviews with key stakeholders. A number of 1,858 farmers participated in the baseline survey out of which a random sample of 656 farmers was approached for the evaluation survey. A number of 16 FGDs covering 6 different regions in Indonesia took place with in total 143 participants. An additional 10 in-depth interviews were conducted among the main stakeholders (e.g. Ewindo, trainers and product promotors). The so-called H-diagram was used in the FGDs, a tool for a structured and participatory discussion to reveal the strengths and weaknesses of an intervention and to discuss on concrete recommendations.

Training of trainers of 137 product promotors of Ewindo

Knowledge was transferred via the training of trainers (ToT) and training of farmers (ToF) model in the period from 2014 to 2017. In total 137 staff members of Ewindo were trained and provided with equipment. These trainers were trained to provide three training modules to farmers. Two ToT for so-called Champion Trainers were held in 2016 in Purwakarta and Lembang with 30 participants. These champion trainers were equipped with more advanced and up-to-date knowledge and tools. They serve as resource persons within Ewindo for peer trainers and farmers in their respected areas.

A 3-day training with focus on hot pepper, tomato and cucumber

The trainings focused on three main vegetable crops: hot pepper, tomato and cucumber. These three crops are the main vegetable crops produced by farmers and relatively difficult to successfully produce. If a farmer succeeds in these horticulture crops, it is assumed s/he will be able to produce other vegetables as well. The farmers received a 3-day training (i.e. three modules) on GAP consisting of theoretical information, demonstration of production techniques as well opportunities for farmers to practice new production techniques. The main training topics were: (i) Planting material, (ii) Fertilisation, (ii), Crop protection, (iv) Occupational Health.

KT reaches out to more than 10,000 smallholder farmers

At the end of the KT intervention, module 1 was followed by 11,602 farmers; module 1 + 2 by 10,834 farmers and module 1, 2 + 3 by 10,185 farmers. Not all farmers followed the three modules. From the total number of farmers reached (32,621), 31% followed the complete training package with the three modules. The majority of outreach was in North and West Sumatra (23% of total trained farmers). The trainers were supposed to distribute the crop manuals to all farmers who participated in the trainings. Most but not all farmers received the crop manuals on hot pepper, tomato and cucumber. In addition, 720 masks (PPE), 790 Edugames on occupational health, 1,346 leaflets, 1,269 booklets and 609 pesticide safety brochures were distributed. Also E-learning modules on crop protection, spraying techniques, crop fertilisation and nursery management were launched on the website of vegIMPACT.

Farmers give an average score of 7.6 (on a 1-10 scale) for the trainings

Using the H-diagram, farmers gave a score to the intervention anonymously. Their average score was 7.6 with a range of 1-10, with 10 being the highest score. In the FGDs, farmers reflected in an open and participatory way on the weak and strong elements of the trainings and they gave several recommendations. In general, farmers underscore the importance of the trainings as it provided access to new and up-to-date agricultural knowledge. A weak point of the trainings was that they contained too much information that was dealt with in a short period of time.

Overall knowledge on agricultural practices has increased thanks to the trainings

Overall knowledge on agricultural practices of farmers has increased due to the KT trainings. The survey results show positive changes in the knowledge of farmers and the qualitative data confirm that these changes can be attributed to the training.

Barriers in knowledge transfer relate to organisation of trainings and farmers' profile

Not all envisioned knowledge has been successfully transferred. According to respondents in the FGD, this relates to broadly two levels: the farmers' characteristics and the organisation of the intervention.

At farmer level:

- Farmers are convinced of own practices applied.
- Information was too difficult because of low level of education.
- Farmers did not follow all three modules.

At intervention level:

- Profile of the trainers (i.e. sometimes too young, unexperienced, not from the same location as the farmers).
- Capability of the product promotor as a trainer: the product promotors are not selected as trainers or educated as a trainer; some are more talented and have more pedagogic skills than others. This can influence the quality of the training and how the information is received by farmers.
- Too many topics in a short period of time.
- Too much theory; more practice is desired.

Increase in vegetable area, changes in pest management, use of fertiliser and occupational health but seasonal differences

In general, the survey results on good agricultural practices show positive changes. The average farm size increased and the majority of the farm area is used for vegetable production. However, there are differences among the seasons: the vegetable area increased in the wet season and decreased in the dry season at the expense of non-vegetable crops. The number of farmers that produce a certain vegetable crop varies by crop and season. But a positive outcome is increase of the average acreage cultivated with the three crops of the training, i.e. hot pepper, tomato and cucumber. The main positive changes

are in the domain of integrated pest management (e.g. less mixing of pesticides) and occupational health, despite some mixed results on the use of personal protection equipment (PPE). In the survey, farmers indicated to use PPE but in the FGDs farmers explained that they understand the need of protection but that they are not motivated to use it. Besides, the majority of the farmers hire contract workers to apply pesticides. An important note in adoption of integrated pest management relates to the season of production. In the interviews and FGDs, farmers indicated that they adopted GAP in the dry season. In the wet season, however, they found it too risky to reduce pesticides.

Limited adoption due to lack of knowledge transfer, distrust and risk averseness of farmers and external influences

Not all information of the trainings has successfully reached the farmers while implementation of other recommendations appeared impractical, unavailable or inaccessible for farmers. Not all farmers are convinced or are able to absorb, and embrace the new knowledge. This has to do with their personal characteristics but also to external influences and dynamics. Individual characteristics like gender, age, experience, education, firm size, wealth and proximity to the market and being member of a farmer group could lead to differences in the uptake of improved practices. So-called front-runners (i.e. the early adopters) can play an important role in the adoption of new technologies (Meijer et al. 2015, NR International 2000). In addition, the adoption of most GAP is commonly understood as investment decisions that require capital and labour resources and access to knowledge, information and training. Such investment decisions are guided by perceived risk, while many poor farmers are risk-averse (Barham et al. 2014; Feder et al. 1985). There are also external factors which affect adoption such as i) the presence of active pesticide agents promoting their products and rewarding purchases, ii) limited capacity of public extension to support farmers facing problems with the implementation of a new technology, and iii) unreliable climatological conditions that seem to increase due to climate change and making management decisions more difficult.

Overall positive effects of trainings but no shocking changes

Tables S.1 and S.2 present the overall results on the ultimate outcome indicators, i.e. productivity, production costs and crop earnings. The tables show positive as well as negative indicator changes with variation between season and crop. Most striking changes:

- An increase in average acreage cultivated with the three vegetable crops hot pepper, tomato and cucumber.
- A significant decrease in tomato productivity in the wet season.
- A significant decrease in tomato production costs (in the wet season only), but not for cucumber and hot pepper.
- Farmers received a lower price for cucumber in the dry season, but there were no significant price changes for tomato or hot pepper.
- Average crop earnings decreased significantly for tomato (in the wet season), not for cucumber and hot pepper.

Table S.1 Summary survey results per season on ultimate outcome indicators (0 = no change, + = increase, - = decrease, * = difference is significant)

	Dry season					
	Area	Yield	Price	Earnings	Production costs	Margin
H. Pepper	+	-	+	+	+	+
Tomato	+*	+	+	+	-	+
Cucumber	+	+	-*	+	+	+
	Wet season					
	Area	Yield	Price	Earnings	Production costs	Margin
H. Pepper	+	+	0	+	+	+
Tomato	+*	-*	0	-*	-*	-*
Cucumber	+	+	-	+	+	+

Mixed results on productivity and earnings from FGD and interviews

Production costs, yields, earnings and margins were also important topics in the FGDs and the interviews. There was consensus among farmers that production costs had decreased in the dry season but increased in the wet season. Farmers unanimously indicated that it is too risky to use less

pesticides in the wet season. However, opinions of farmers on yield changes and prices varied. In general, the farmers follow market prices, i.e. they all start to produce the same crop when the price is high, resulting in oversupply at harvest and consequently low market prices. Financial margins increased for all crop and season combinations except for a significant decrease for tomato in the wet season.

Table S.2 Overview of KT Objectives and conclusions

Indicators KT	Conclusion
Increased vegetable area	Yes for all crops in both seasons
Increased vegetable productivity	Yields of four of the six crop-season combinations increased
Reduced pesticide use per unit product	unknown, but indication that less pesticides are applied in the dry season
Reduced nitrogen fertiliser use per unit product	unknown but indication that farmers are more aware of the correct volumes to apply
Reduced production costs per ha	Total Production costs increased for most crop and season combinations except for tomato dry season
Reduced occupational health problems and risk	Survey data show that farmers use more PPE and report less pesticide-related health problems; qualitative data give less positive results

Various reasons for mixed effects at ultimate outcome level

There are various plausible explanations of the mixed effect of the trainings on the objectives *(i.e. yield, cost price, reduced pesticide and fertiliser use, and area expansion)*. The first remark is in line with the intervention logic as not all farmers apply the lessons learnt and adopted GAP.

Fluctuating market prices of horticulture undermine potential impact

Other plausible explanations are the external influences and assumptions underlying the theory of change such as the extremely volatile market prices of horticulture crops. While the governmental regulates rice prices, horticulture lacks any price regulation.

Unpredictable weather, climate change and risk of pest and diseases outbreaks are important limiting factors

Another important contextual factor which explains limited changes can be found in climate change. Indonesia traditionally knows two seasons, the wet and dry season, which are becoming less predictable due to climate change. This makes traditional management decisions, for example, related to planting and pest and disease control less effective. New information and decision-support tools are required to help farmers to deal with more variable seasonal weather conditions.

Recommendations and lessons learnt

Although the results at different result levels of the Theory of Change are quite favourable, the intervention can be improved for more success. Based on all data collected, the lessons learnt are the following.

- **Quantity versus quality:** The target of training 10,000 farmers was realised by quite a margin. The implementers acknowledged that quality could be at risk when there is too much focus on the number of farmers.

- **Less is more, balance theory and practice:** Closely related to the previous point is to focus on a number of topics and to teach by repetition, i.e. less is more.

- **Who to approach: Better definition of target clients:** The trainers (product promoters) were not instructed or guided in selecting the farmers for the trainings. Obviously, the composition of the trained farmers has consequences for the training material and means of knowledge transfer, but also for the objectives of knowledge transfer.

- **No one-size-fits-all approach:** The same KT intervention is applied all over Indonesia. Each island or region is unique in terms of agricultural practices, culture, socio-economic and institutional conditions, environment, farmer group dynamics, politics and market prices and politics. Although resource intensive, a more tailor-made model should be designed for maximum and sustainable impact.

- **Align and balance objectives of company and foundation:** Partly related to the last two points, it is important for Ewindo and YBTS to balance and align their targets of increased sales (Ewindo) and CSR outreach of farmers (YBTS). It is recommended that the company and the foundation have a common strategy.

- **Refreshment of trainers and up-to-date knowledge:** The farmers as well as the trainers all agree that it is crucial that the trainings are refreshed, especially with respect to pest and disease management.

The model of KT is potentially sustainable

The design of KT is potentially sustainable as KT is implemented by a local well-established commercial company and its foundation. The intervention does not only aim at providing support to farmers but the company has its own interests and benefits from success of the programme, namely more seed sales. This is a very important element in the sustainability of an intervention and success in the long run.

Evaluation methodology: effective and meaningful but with room for improvement

The applied mixed method provides good and valid insights on the uptake of knowledge and practises, and thus the ToC of the KT work package of VegIMPACT. However, the methodology has some limitations and recommendations are given to improve evaluation measurements in future similar interventions.

- The pipeline approach in order to create an internal counterfactual.
- Incorporate a clear selection strategy or definition of farmers to be trained.
- make use of the existing structures and communication structures of Ewindo to collect data (e.g. on regional seed sales), for monitoring as well as evaluation purposes.

1

Introduction and context

Introduction and context

Low food and nutrition security in Indonesia

Food security in Indonesia is an issue, because of the overall availability of food (rice) but increasingly also because of the distribution and differences in (physical and economic) access to food. The World Food Programme (WFP) indicates that is heavily influenced by factors like poverty and lack of infrastructure. High food prices compound the situation. As a result, 19.4 million people are unable to meet their dietary requirements. Poorly varied diets, based mainly on rice, mean that the country is faced with three simultaneous nutrition-related challenges:[1]

- More than 37% of children under 5 suffer from stunted growth due to malnutrition, with higher prevalence among families reliant on subsistence farming or living in slums.
- Almost one quarter of women of reproductive age are anaemic, and
- An increasing number of people over the age of 15 are overweight or obese.

Development of the agricultural sector lags behind

According to the OECD, the agricultural sector of Indonesia is underperforming. The development of the agricultural sector lags behind because of a low investment in Agriculture and R&D, but also poor logistics and lack of national and international investments in agriculture play a role. Most farmers apply low technology levels, productivity needs to be increased, costs of production need to be lowered and quality of produce needs to be improved. The link between production and markets/consumers should be enhanced through better targeting of production to consumer demands. Most of the agricultural produce, also commodities exported, is not processed. There are ample opportunities for value adding in the agricultural commodity chains.

Policy shift towards agricultural diversification and horticulture

The Government of Indonesia has long focused on rice for food security and food self-sufficiency. Lately, the (food security) policy is shifting towards agricultural diversification and especially also the horticulture and fisheries sectors are gaining interest. Most of the food produced in Indonesia is for the domestic market, including food from the horticulture, fisheries and aquaculture sectors. There is an emerging urban middle class increasingly buying their food in supermarkets, and demanding high quality food (quality and food safety). In addition, the traditional vegetable markets remain important. In order to guarantee sufficient supplies to both market channels, attention is not only required for improved production technologies but also for food handling, food quality assurance and food safety. There is room for increasing the involvement of the private sector in food production, food processing and value chain development. In this respect, lessons can be learnt from the involvement of private sector in export-oriented value chains and these can be translated into food produced for the domestic market. Important aspects are enhancing food quality and shelf life of produce.

Urgent need for improving knowledge of good agricultural practices

The vegIMPACT programme, short for ‘vegetable production and marketing with impact’, was designed in this context of low food and nutrition security, rural poverty and the potential in the agricultural sector. In the inception phase an intensive mission took place between WUR experts and the Dutch Embassy to feed the planned intervention. The major observations in the horticulture sector were the following:

- Agricultural productivity is generally low, and production practices do not always allow for a maximum productivity;
- The use of agricultural input, specifically fertilisers and pesticides is too high, and reduction can lead to a substantial increase in farmers’ incomes.

[1] www1.wfp.org/countries/indonesia

- Farmers are eager to pick up new production methods, but are also risk aversive.
- The level of co-operative organisation of farmers is low.
- Improved production practices might need investment (net houses, improved construction for plastic houses). The access to capital for individual farmers is limited, and farmers are hesitant to invest.
- Market developments in Indonesia with an increasing amount of consumers buying their food in supermarkets offers new opportunities for farmers to supply these consumers.

Indonesia's agriculture and national food security policy is traditionally focused on rice, but there were multiple reasons to provide technical support to Indonesia's horticulture sector

The observations of the inception mission were combined with desk study and various consultations of experts. It appeared that a focus on horticulture while addressing food security was interesting from multiple perspectives (van Dorp et al. 2012). Horticulture is beneficial from a viewpoint of agricultural diversification for a sector that is dominated by rice production. Agricultural diversification, and thus the increased availability and consumption of vegetables, contributes to reducing widespread micro-nutrient deficiencies and food and nutrient security of the Indonesian population that increasingly lives in urban areas. At the same time, poverty and food insecurity are high in the rural areas of Indonesia. Stimulating vegetable production and market linkages could provide farming families with an income to ensure their access to food. Experts considered improvements in productivity, resource use efficiencies and product quality of vegetables very well possible considering the current means of production. Related to the potential for technical improvements in vegetable production, current high levels of pesticide use were not considered effective in terms of productivity by experts but formed an important share of the production costs. In addition, the high pesticide level posed a largely unhidden and undesired occupational health risk for farmers and labourers, of which a large share is female. Furthermore, development of horticultural value chains creates new off-farm employment opportunities for both rural and urban households. Last but not least, Dutch knowledge institutes and Dutch private sector companies had a broad experience in the issues identified and could add value to the development of the horticultural sector in Indonesia.

The programme vegIMPACT aims to contribute to increased food security and private sector development in Indonesia

The above-mentioned challenges and problem analysis led to the focus on i) horticulture and ii) good agricultural practices. To respond to the urgent need for improved knowledge on good agricultural practices, market access vegIMPACT was designed. The vegIMPACT programme aims to improve vegetable production and marketing of small farmers in Indonesia. As such, VegIMPACT aims to contribute to increased food security and private sector development in Indonesia. The programme is financed by the Dutch government and is carried out by Wageningen University and Research Centre (WUR) together with local partners and national and international companies in vegetable production and marketing (2012-2017).

Key elements of vegIMPACT are practical training and capacity building of smallholder farmers concerning good agricultural practices and marketing

VegIMPACT consists of different intervention strategies. Many of them focus on practical training and capacity building of farmers and other stakeholders in vegetable chains. Also in the Work Package Knowledge Transfer (KT), many smallholder farmers were trained in a close partnership with the company East West Seed Indonesia (Ewindo) and its foundation YBTS (*Yayasan Bina Tani Sejahtera)*. Knowledge was transferred via the training of trainers (ToT) and training of farmers (ToF) model. Field staff (product promotors) of Ewindo were trained by VegIMPACT and IVEGRI experts who in turn trained thousands of farmers in their region in the period from 2014 to 2017.

A win-win situation with partnership between Ewindo and vegIMPACT

By partnering with Ewindo a win-win situation was created: Ewindo was provided with state-of the-art knowledge on vegetable production and vegIMPACT got access 'to the last mile', i.e. using Ewindo's infrastructure and presence across Indonesia thousands of small farmers became into reach of vegIMPACT. An additional benefit of collaboration with a commercial company like Ewindo was the potential sustainable use of the provided knowledge after programme ending. Ewindo used the trainings to stimulate horticultural production across Indonesia, which would provide new market opportunities to sell more high-quality vegetable seed.

The intervention logic of vegIMPACT relies on Knowledge Transfer

The vegIMPACT programme is designed to achieve an increased vegetable production of higher quality leading to higher farm incomes and more vegetable consumption. The programme promotes good agricultural practices, the use of good quality seed and crop planting schedules and trains farmers in collective action, market access and contractual arrangements. All activities are based on the assumptions that the sharing of knowledge on improved practices (knowledge and awareness) will result in improved practices. To capture this we applied a survey design based on the KAP model (Knowledge – Attitude – Practices) (MdM 2011, WHO 2008) to collect information on what is known, believed and done in relation to the topics of Knowledge Transfer (KT).

The right knowledge and being convinced will lead to change in behaviour and attitude

Farmers and other relevant stakeholders (e.g. extension workers) were trained on specific technical issues. Training was given in theory as well as in practice (demonstration fields); it is expected that they will change their attitude and behaviour after having the right knowledge and being convinced by the results in practice. The assumption is that behavioural change results in the adoption of the learnings, which results in a different farming and marketing strategy.

The intervention logic and the design of the WP M&E is based on this KAP-model. The intervention logic is based on previous programmes and studies and is elaborated upon in the next chapter.

Delivering solid proof of the programmes' effectiveness is important

The evaluation study intends to deliver solid proof of the effectiveness of the intervention by assessing (changes in) agricultural practices, production, and productivity of the three crops of the trainings: tomato, hot pepper and cucumber. The qualitative data provide important insights for the discussion on explaining effects, the limitations of the intervention logic and contextual barriers and enables. The study also reflects on the methodology of the work package M&E, its pros and cons, the validation and representation of the results presented.

This report provides a detailed description of the intervention logic (Chapter 2), the methodology used (Chapter 3), the characteristics of the target group (Chapter 4), the results of the study (Chapter 5-7) and conclusions and recommendations for policy (Chapter 8).

2

Theory of Change

Theory of Change

The overall objective of vegIMPACT is to enhance the economic and environmental sustainability of vegetable production

The overall objective of the vegIMPACT programme is: 'To contribute to the improved food security and improved competitiveness of Indonesian farmers.' Achieving this objective requires that farmers use different (i.e. better) agricultural practices, produce more vegetables of higher quality and reduce the cost of production leading to improved farm income. Therefore, vegIMPACT has rolled-out at a large scale farmer training activities in good agricultural practices in the WP Knowledge Transfer (KT). With the implementers of vegIMPACT, WP M&E developed a Theory of Change (ToC) for all activities (Appendix 1b) including one for the WP KT (Figure 2.1 and Appendix 1a). The success of an intervention depends not only on the way it is implemented and the skills and capacity of implementers but also on the logic of the ToC.

It is assumed that the vegIMPACT interventions will lead to an increase in production, an increase in productivity, reduced costs, increased labour opportunities and a reduction of pesticide use

The result chain in Figure 2.1 shows how the different vegIMPACT interventions contribute to and result in the planned outputs, outcomes and impact. In the result chain, the various steps in the causal chain are explained and the interrelationships between the activities of the intervention and the resulting outputs, outcomes and impacts are made explicit. The vegIMPACT result chain includes various assumptions about preconditions and the external environment and institutions. At each result level assumptions are indicated which became clear during the definition of the ToC. As a process the ToC is continuously subject to change by new insights, learnings and changes in the external conditions. Overall, it is assumed that the vegIMPACT interventions will lead to an increase in production, an increase in productivity, reduced costs, increased labour opportunities and a reduction of pesticide use (performance indicators). These results contribute to the overarching programme goal of food security and private sector development in Indonesia.

Enabling environment and external barriers hampering success of interventions are important for programme success

Not explicitly mentioned but very important are the external conditions, i.e. events, actors or institutions unrelated to the intervention that contribute to the realisation of the intended results. These external conditions include other interventions with similar aims, general economic or social trends and changes in policy. For example, a reduction of the price of vegetables can explain an increase in vegetable consumption that is unrelated to the training intervention. A negative external influence could be a strong and influential PR strategy of a pesticide company or government policy (e.g. subsidising rice inputs) which conflicts with the programme objectives.

Focus on effects of the training on immediate and intermediate outcomes, means no claims on food security

Development effects are the effects on beneficiaries as the result of an intervention, and which are in the sphere of interest of the intervention. The ambition of KT is to contribute to the improved food security and improved competitiveness of farmers. However, to show statistically significant net-effects on these areas are unlikely within the scope of influence of this programme and the available resources. The effects of interventions on improved socio-economic status and food and nutrition security are hard to control for and,[2] therefore, definitely difficult to measure, especially in a small sample of beneficiaries per region and in the absence of a comparison group

[2] Improved income does not automatically lead to more household expenditures on (healthy) food consumption.

which has not been targeted by the intervention.[3] The evaluation of the underlying intervention therefore focuses on analysing effects of the training on immediate and intermediate outcomes, i.e. the knowledge obtained, practices adopted and productivity levels. The next chapter explains further the methodology of data collection along the result chain. Table 2.1 gives an overview of the different result levels and indicators used to verify the contribution of the training to the expected results.

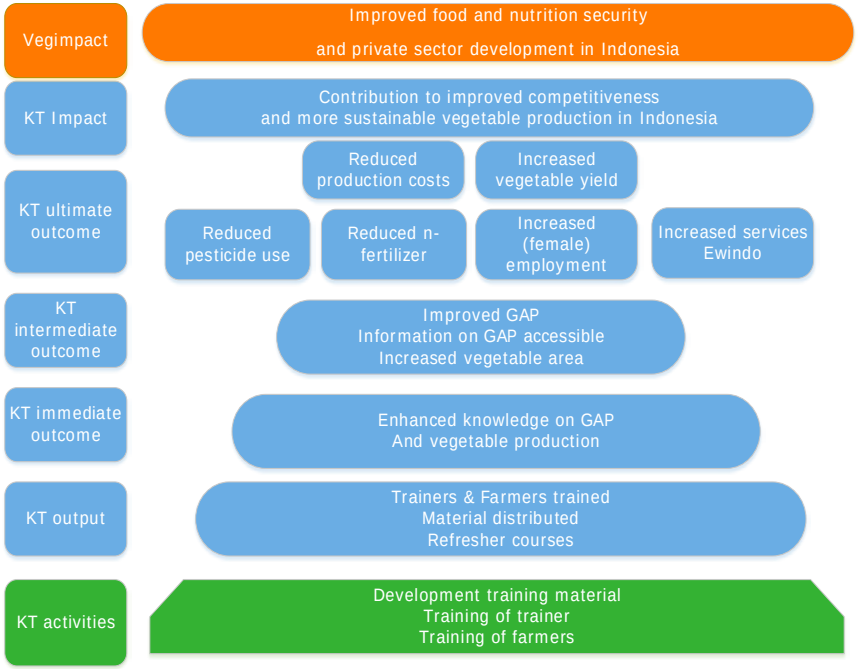

Figure 2.1 Theory of Change of Knowledge Transfer (Appendix 1a)

Improved practices result in sustainable practices, higher productivity and increased income

Adoption and uptake by the trained farmers is assumed to lead to improved agricultural practices, improved input use with high quality seed and improved practices of planning and control (planting schedules) and market access (collective action and contractual arrangements). These in turn lead to lower production costs, lower pesticide use and higher productivity. The improvements in farming potentially can also lead to higher quality of crops, which may result in higher prices. Higher productivity in combination with lower cost price and higher prices leads to increased gross income at producer level (ultimate outcomes). WP KT focused on three crops: hot pepper, tomato and cucumber. These three crops are the main vegetable crops produced by farmers and relatively difficult to successfully produce. If a farmer succeeds in these horticulture crops, it is assumed he will be able to produce other vegetables as well.

Performance indicators were formulated based on the ToC

A number of performance indicators have been identified at programme development in collaboration with the client, the Ministry of foreign Affairs in the Netherlands. These indicators relate to the outcome level and are based on the ToC. The M&E methods cover and measure the following indicators:[4]

1. Increased vegetable area
2. Increased vegetable productivity
3. Reduced pesticide use per unit product
4. Reduced nitrogen fertiliser use per unit product
5. Reduced production costs per hectare
6. Reduced occupational health problems and risk
7. *Increased employment*
8. *Increased female employment*
9. *Improved R&D and extension services*
10. *Increased availability of private sector products and services*

Not all indicators were measured within the M&E work package. Increased (female) employment, and the indicators at private sector level, i.e. improved R&D and extension services and increased availailability of private sector products and services, were not taken into account. Table 2.1 gives an overview of the result levels and their scope of influence, the indicators and assumptions per envisioned result.

[3] Because of a limitation of resources.

[4] A farmer's profit depends on the market prices. As horticulture market prices are very volatile and beyond the scope of control we did not set farmers' profit as one of the programmes' indicators although we do present results on financial margins.

Table 2.1 Indicators and assumptions at different result levels

Influence of intervention	Result levels	Result	Description indicators and measurement	Assumption
High	Outputs	Programme activities conducted (e.g. training material developed, ToT and ToF conducted, manuals printed)	Training materials developed, number of trainings conducted, (ToT and ToF), measuring via annual reports Ewindo, manuals printed, attendance sheets, etc.)	Project is relevant and people need the intervention, project is the right solution for the defined problems, enough resources are available, legal grounds for operation
Medium	Outcomes	The effects and changes that occur as a result of the intervention, here labelled as immediate, intermediate and ultimate changes. Effects and the consequences of the actions taken by the farmers thanks to the outputs, frequently focus on behaviour changes which become manifest as changes in practices (adoption).		
Medium	Immediate outcome	Enhanced knowledge on cultivation practices due to the training received	Indicators: appreciation, satisfaction, knowledge shared with others (as indication of relevance and appreciation); knowledge questions on topics of training (e.g. recognition of disease, spraying interval, types of pesticides used)	The right message, people, staff, timing, message is understandable, message is applicable, people want to be trained and willing to learn
Low	Intermediate outcome	Changes in agricultural practices thanks to increased knowledge	A. Improved spray practices: i) Direction of spraying, nozzle replacement, time of spraying, drop size, contributing to efficient and effective use of pesticide. ii) Increased use of personal protective equipment contributing to a reduced occupational health risks.	Changes in agricultural practices thanks to increased knowledge
Lower	Ultimate outcomes	Increased vegetable area, improved yield and income, reduced cost price, decreased pesticide use, increased labour crop, reduced occupational health risks, thanks to adapted agricultural practices	A. Production increases: farmers increase the area under vegetables.	Increased vegetable area, improved yield and income, reduced cost price, decreased pesticide use, increased labour crop, reduced occupational health risks, thanks to adapted agricultural practices
Lowest	Impact	B. Productivity increases: Thanks to GAP crop productivity increases.		B. Productivity increases: Thanks to GAP crop productivity increases.

3

Evaluation Methodology

Evaluation Methodology

Accountability and learning objectives of the evaluation

A well-conducted evaluation is crucial to demonstrate the level of success of the project, i.e. the effectivity of the intervention to bring about large-scale adoption of improved techniques and best practices, and to translate learnings in a road map for sustainable vegetable production. The design of the evaluation follows the central question: 'Did we do the right things and did we do the things in the right way?' To be able to do so, the study provides insights into the application of the ToC and the mechanisms at work in (non) achievement of objectives. The objectives are twofold: i) accountability and ii) learning: to measure change up to outcome levels and to learn for improvement.

Mixed methods applied: quantitative and qualitative

A mixed-method approach is applied: a before and after survey is used in combination with focus group discussions (FGDs) with farmer participants and interviews with key stakeholders. A number of 1,858 farmers participated in the baseline out of which a random sample of 656 farmers was approached for the evaluation survey (Appendix 2 presents the survey). A number of 16 FGDs covering 6 different regions in Indonesia took place with in total 143 participants. An additional 10 in-depth interviews were conducted among the main stakeholders (Table 3.2). The so called H-diagram was used in the FGD (Appendix 3 and Figure 3.1). The H-diagram is a tool for a structured and participatory discussion to reveal the strengths and weaknesses of an intervention and to discuss on concrete recommendations.

The farmer survey customised to local context and pilot tested

A draft survey was developed based on the ToC of vegIMPACT and specifically of KT, on the local context, and the available literature on impact of comparable interventions. This survey was discussed, refined and customised with the main stakeholders in 2014. Subsequently, the survey was translated and pre-tested in the field. Data were encoded into Excel by the local M&E team member of our local support office and data quality was checked by WUR team members. The evaluation survey was conducted by phone by two well-trained external consultants. The first batch of farmers was surveyed for the second time in April 2016 and the second batch in August 2016. We decided to split the farmers in two groups according to the moment the farmers were trained in 2014. The decision to approach the farmers by phone was due to limited resources. As Indonesia is a very large country and the intervention took place all over the country, it was impossible to personally visit the farmers to conduct the evaluation survey face to face. The survey by phone potentially leads to a bias as we only could interview farmers with a phone (e.g. an assumption could be that the farmers with a phone are the ones with higher incomes meaning that the group of respondents is not representative). Therefore, the FGDs and interviews were complementary to the telephonic surveys. The FGDs were randomly conducted among all farmers being trained and all participants of the group were invited to join and actively participate.

Survey on farm(er) characteristics, agricultural practices and production

At the start of the programme we did not know whether all farmers targeted would follow all foreseen modules. Besides, the trainers had some freedom to customise the training according to the main needs of the farmers in their training group. Therefore, the survey covers the most important topics which all farmers would be trained on. The survey was translated and pretested in the field. The survey consisted of the following sections:

- Farmer characteristics
- Farm characteristics
- Main crop characteristics
- Revenue main crop
- Agricultural practices & knowledge
- Health and personal protective equipment (PPE)

A total of 1,858 farmers completed the baseline survey before the first training in 2014

Not all farmers were trained in the same year. To see concrete changes and perceived impact, time is needed between the training, the adoption of the learnings and the results in terms of productivity and profit. As there was no clear timeline of whom to train when and where, we decided to conduct the baseline among the farmers who were trained in the first year, i.e. 2014. As a consequence there could be some bias as the implementers adjusted some elements in the course by forthcoming insight. We do not expect a large bias but the trainers learnt and improved by doing (i.e. providing the trainings) and as such became more experienced as a trainer. It could be that they improved in transferring knowledge in due course of the KT programme assuming a better knowledge transfer. We followed the choices of Ewindo in the selection of regions and training locations. As such, the baseline was conducted at each training on Module 1 of the first year so all farmers who participated in the first year participated as respondent in the baseline. We conducted the baseline among 1,858 farmers from different regions: East, West and Central Java, Sulawesi, Sumatra, Kalimantan, Flores and Moluccas. The farmers were surveyed before the training started and this was coordinated by the field staff (i.e. the Ewindo product promotors) and lasted 30 minutes. Section 4 provides a summary of the main characteristics of the sample of the baseline as well as the sample used as panel data.

A total of 656 farmers (35% of baseline sample) participated in the evaluation survey

For the evaluation survey we excluded farmers who were a) not willing to participate in the evaluation survey (n=14) and b) who either did not have a phone or did not want to give their number (n=841). This resulted in a sample size for the evaluation of 1,003 farmers (=1,858 minus 855). These farmers were all approached, leading to a final sample of 656 farmers participating in the evaluation. When approached, not all farmers were willing to participate or could not be reached via the phone number given at the baseline; the response rate was 65%. The analysis is based on the averages of the farmers per crop and season for the baseline and the endline.

The farmers selected for panel data are a representative sample of the baseline farmers

Table 3.1 provides an overview of the main characteristics of the farmers in the baseline (n=1,858) compared to the evaluation (n=642). It shows that the smaller sample of the evaluation survey is representative for the larger baseline cohort of farmers in terms of personal, household and main farm characteristics (i.e. observable characteristics). However, compared to the national statistics reported by BPS (2014) the surveyed farmers have a higher level of education and have a larger farm size. Other indicators like the division between male and female are comparable to the national statistics.

Table 3.1 Characteristics of the respondents baseline and evaluation survey

Personal and household Characteristics	Baseline	Evaluation
Total	1,858	642
female	7%	6.8%
male	93%	93.2%
Average age	39.7	40.7
Average household size	4.2	4.4
Average education level		
senior high school	44%	44%
elementary school	24%	24%
middle school	26%	26%
Experience in vegetable (yrs)	7.8	10.3
Member of farmer group	82%	85%
Average farm size in m^2	5,7	8,3
Owned land	48%	49%
Rented land	33%	32%
Both rented and owned land	19%	19%
Average land use dry season		
non-horticulture	6.7%	8.9%
horticulture	93.3%	91.1%
Average land use wet season		
non-horticulture	16.3%	9.6%
horticulture	83.7%	90.4%
Crops most frequently mentioned in the dry season	1. Hot pepper 2. Tomato 3. Cucumber 4. Eggplant	1. Tomato 2. Curly chili 3. Hot pepper 4. Cucumber
Crops most frequently mentioned in the wet season	1. Hot pepper 2. Tomato 3. Rice 4. Long been	1. Tomato 2. Curly chili 3. Hot pepper 4. Rice

Qualitative data collection: FGD and interview topics

All the FGD and interviews were conducted by the Wageningen Economic Research evaluator involved in collaboration with the local M&E officer of the LSO. The FGD and interviews were structured alongside the following topics:

- Relevance of the trainings for farmers (i.e. matching their knowledge need).
- Appreciation and satisfaction of the trainings (0-10 score).
- Reflection on KT as a method for knowledge transfer to farmers.
- Effects of trainings on farmer knowledge and practice (skills and application).
- Impacts of trainings (e.g. income of vegetable crops, cost price reduction).
- Sustainability of the intervention and of training results.

Table 3.2 Information on respondents of the focus group discussions

Period	Region	FGD group	Participants		H-diagram
			Male	*Female*	
October 2015 – February, March 2016	Java, West	7	51	4	5
October 2015	Flores	2	11	4	1
April 2016	Java, Central	2	19	7	1
	Yogyakarta	1	8	2	1
Augustus 16	Lombok	2	18	0	1
	Sulawesi	*2*	*19*	*0*	*1*
Subtotal participants			126	17	
Total participants		16	143		10

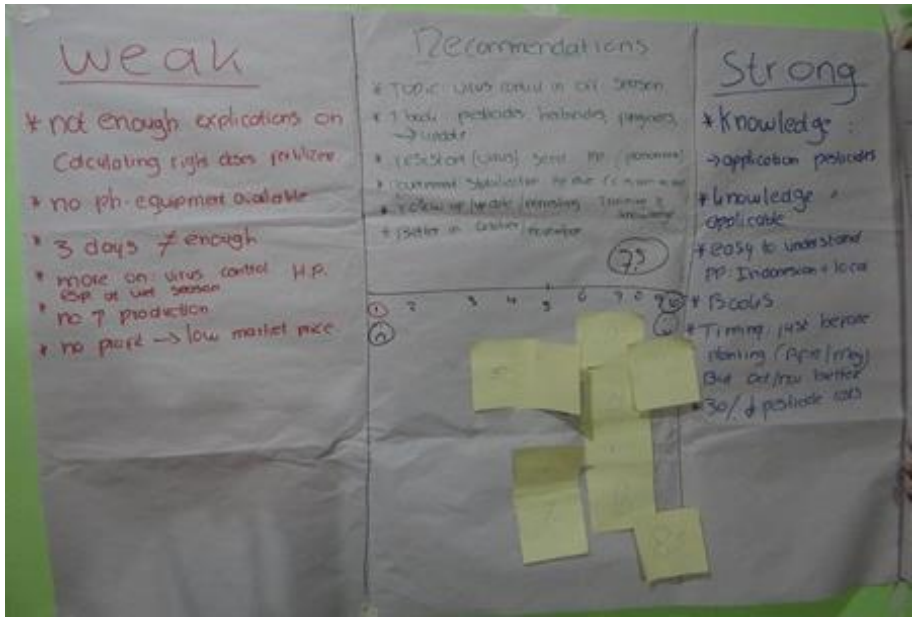

Figure 3.1 Illustration of H-diagram used during FGD

Focus on three crops and panel data result in very small sample size

Results are presented at output and outcome levels to follow the intervention logic of the programme. Of the quantitative results we present the mean, sample size (n), minimum and maximum and standard deviation (Appendix 4). In our analysis of the intermediate and ultimate outcomes of the intervention, we distinguish between seasons as Indonesia knows two seasons per year, a dry season and a wet season. Both are very different in terms of weather conditions, which may affect crop management and crop performance. As such, we compare the baseline dry season with the evaluation dry season and the baseline wet season with the evaluation wet season. We focus on the crops of the training, i.e. tomato, hot pepper and cucumber. To show behavioural changes concerning what type of crops the farmers produce, we compare the farmers of the baseline and evaluation. And we hope to see that in line with the programmes' objectives more farmers produce vegetables.

The analysis was done twofold: at group and at farmer level

Only the farmers producing tomato, hot pepper or cucumber at the time of the baseline and the evaluation are taken into account. As such, results of farmers producing another crop are not presented. The evaluation should provide two main insights: i) did the number of farmers producing tomato, hot pepper and/or cucumber increase (i.e. did farmers change from rice cultivation to for example hot pepper production) ii) did the farmers who already produced these crops improve their cultivation practices and farm income in these crops? Therefore, the analysis for the ultimate outcome variables is twofold:

i) At group level: results of the group of farmers producing tomato, hot pepper or cucumber in the baseline in the dry or wet season compared to the group of farmers producing that crop in the evaluation in the dry or wet season. Results are compared on averages of the groups but composition of the group differs between the baseline and evaluation. Hence, the analyses compare the average farmer producing a certain crop in 2014 with the average farmer producing that same crop (even though this group now consists of different individuals) in 2016.

ii) At farmer level: comparison is done on the same farmers producing the same crop in the same season in the baseline as in the evaluation. Hence, the analyses compare the results of farmers who produced a certain crop in 2014 with their results in 2016. The groups in both years now consist of the same individuals.

Small sample size hinders application of regression analysis

In general the number of respondents turns out to be quite low when considering the three crops, the two seasons, the missing values and the outliers. Especially, the number of respondents at farmer level turns out to be very low. For cucumber, we only have results on productivity, production costs and earnings for two farmers. This means that there is high variation in vegetable production behaviour, i.e. farmers do not consequently cultivate the

same crop in the same season (dry and/or wet). Because of the low number of respondents, we decided to present the results at farmer level in the Appendix (Appendix 4). As a consequence of the focus on the three crops only, distinguishing per season, exclusion of outliers, and some missing values, the sample size for the same farmer groups (analysis i) turned out to be so small that testing on significance with t-tests and ANOVA was not possible. The results and conclusions in the underlying report are based on the analysis at group level.

Different composition of groups does not allow for manual calculations on earnings and margin

As elaborated upon in the previous paragraph, in some cases (especially concerning the ultimate outcome variables) the respondents in the baseline and endline differ in number of observations and composition. There are missing values for either/and yield, area size, production costs and earnings. In addition, for each variable, outliers were not taken into account. The number of observations differs for each variable and the composition of the groups in either baseline or evaluation differs. It is impossible therefore to manually calculate earnings and margins based on the figures presented in the tables in Chapter 7.

Rich qualitative data compensate for the lack of more advanced quantitative methods on causality

Because of limited sample size we could not use regression analyses to disentangle the influence of KT versus personal (e.g. age, education), household (e.g. household size) and farm characteristics (e.g. land size). However, rich qualitative data were gathered via the FGDs, interviews and H-diagrams providing insight into the relevance and effectiveness of the intervention. In addition, the FGDs provided new insights on constraints that farmers face and enabled the formulation of concrete recommendations for improvements of the training approach.

Challenges of the methodology applied

As mentioned in this chapter, data collection in KT had its challenges considering i) that the trainings were given across entire Indonesia, ii) the uniqueness of each individual island in terms of climate, governance, agricultural practices, culture and socio-economic circumstances, iii) the climatological differences in one year, i.e. the wet and dry season, iv) the variety of crops produced by farmers and v) the fact that the majority of farmers do not keep records on farm activities hampers checking for accuracy. The evaluation framework, instruments and analyses were designed in such a way to take into account these challenges and track on progress with a representative sample. The survey was quite general and therefore applicable across Indonesia. In the analysis, outliers were excluded and if needed observations were cross-checked with local experts. The randomly conducted FGDs and interviews were customised and participatory in character. Rich qualitative data were gathered from different stakeholders and points of departure to complement the quantitative data and to be able to further interpret and enhance learning on the intervention.

4

Output:
KT Activities

Output: More than 10,000 farmers trained

Training of Trainers: 137 staff members were trained and equipped

Training of Trainer (ToT) activities have been held in four locations in 2013 and 2014. The total number of trainers that have been trained are 137 product promotors of Ewindo and its foundation YBTS (*Yayasan Bina Tani Sejahtera*). Selection of the trainers was based on willingness of the product promotors to participate in the programme and their ambition to learn and share knowledge with farmers. Training of farmers took place in seven areas (six sales areas of Ewindo and one area of the foundation YBTS). The targeted farmers in the KT intervention were mainly in the areas where the sales of Ewindo are high. In three days, every product promotor received three modules, i.e. i) agro-ecosystem, seedling management and land preparation; ii) fertiliser, fertilisation, pest & disease introduction, and iii) pesticides mode of action, spraying and pest & disease management. All trainees were provided with a pH meter, water-sensitive papers and a mask. In addition they received training material such as one unit N-check, a water pH and flipchart. WP KT focused on three horticulture crops: hot pepper, tomato and cucumber. Two ToT for so-called Champion Trainers were held in 2016 in Purwakarta and Lembang with 30 participants. These champion trainers were equipped with more advanced and up-to-date knowledge and tools. They serve as resource persons within Ewindo for peer trainers and farmers in their respected areas.

More than 10,000 farmers received a complete training

At the end of 2014, a number of 107 trainers started to train the farmers in the Training of Farmers (ToF) based on the three modules mentioned in the previous paragraph. Mid-2017, module 1 was followed by 11,602 farmers; module 1 + 2 by 10,834 farmers and module 1, 2 + 3 by 10,185 farmers (Figure 4.1 and 4.2 and Table 4.1). Not all farmers followed the three modules. From the total number of farmers reached (32,621), 31% followed all three modules. No in-depth research has been done to explain why some farmers did not complete the training. According to Ewindo these farmers lost interest and had other priorities.

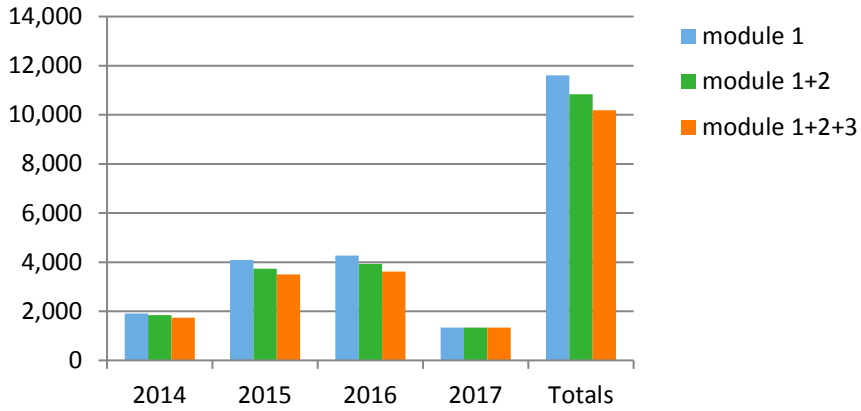

Figure 4.1 Number of farmers trained per module per year

Sales Area	ToF conducted	ToF Locations	*1*	*1+2*	*1+2+3*	Farmers / region	% of total
Area 1	19	122	2,833	2,411	2,217	7,461	23
Area 2	15	42	1,160	1,122	1,078	3,360	10
Area 3	23	96	2,132	2,093	2,066	6,291	19
Area 4	19	83	2,062	1,888	1,609	5,559	17
Area 5	10	38	916	865	804	2,585	8
Area 6	14	45	1,043	1,032	1,006	3,081	9
YBTS	7	50	1,456	1,423	1,405	4,284	13
Total	**107**	**476**	**11,602**	**10,834**	**10,185**	**32,621**	**100**

Table 4.1 Number of farmers trained per module and per region

Majority of farmers trained (23%) in West and North Sumatra

Figure 4.2 and Table 4.1 give an overview of the different realised outputs per Ewindo sales area. The sales areas represent the following regions:

- Sales area 1: West Sumatra, Aceh, North Sumatra, Riau Province

- Sales area 2: South Sumatra, Lampung Province
- Sales area 3: West and Central Java Province, Yogyakarta Special Region
- Sales area 4: East Java, Bali, West and East Nusa Tenggara Province
- Sales area 5: Kalimantan (Borneo Island)
- Sales area 6: North Moluccas & Moluccas Province, Papua & Sulawesi Island
- YBTS area : North Moluccas, East Nusa Tenggara, and West Papua Province

The majority of outreach was in North and West Sumatra (23% of total trained farmers). Most but not all farmers received the crop manuals on hot pepper, tomato and cucumber. The trainers were supposed to distribute the crop manuals to all farmers who participated in the trainings. In addition, 720 masks (PPE), 790 Edugames on occupational health, 1,346 leaflets, 1,269 booklets and 609 pesticide safety brochures were distributed. Also E-learning modules on crop protection, spraying techniques, crop fertilisation and nursery management were launched on the website of vegIMPACT (www.vegimpact-e-learning.com).

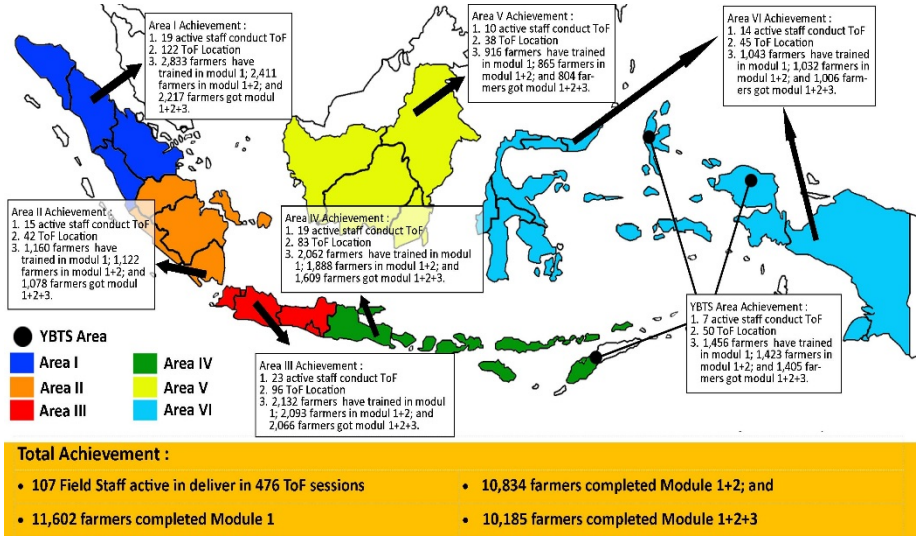

Figure 4.2 Geographical spreading of sales areas and ToF outreach

Table 4.2 Number of female and male farmers trained in module 1 (representative figures for modules 2 and 3)

Area	Sex		Total	Female, %
	Male	Female		
Sales area 1	2,205	628	2,833	23
Sales area 2	1,125	35	1,160	3
Sales area 3	1,960	172	2,132	8
Sales area 4	1,717	291	2,132	14
Sales area 5	821	95	916	10
Sales area 6	993	50	1,043	5
YBTS	481	481	1,456	33
Total	9,850	1,752	11,602	15

Fifteen per cent of farmers trained were female

The majority of the trained farmers was male (85%). Sales area 1, 4 and YBTS had most female participants. Lowest women participation was in sales area 2 (Sumatra) where male farmers have the full responsibility and decision making in horticulture farming (Table 4.2). A map with sales area and outreach per area is presented in Figure 4.3.

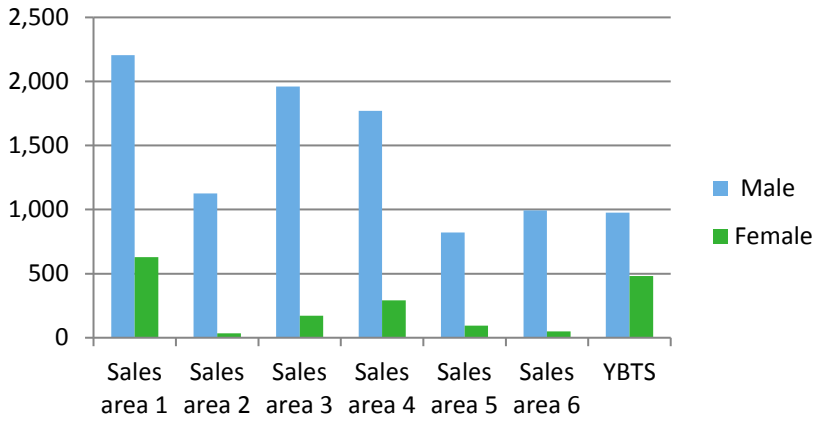

Figure 4.3 Figures of male and female farmers trained per sales area

Farmers give an average score of 7.6 (on a 1-10 scale) for the trainings and adhere great importance to it

With the H-diagram, farmers anonymously gave a score to the intervention in general. Their average score was 7.6 on a of range 1-10 with 10 being the highest score. The intervention was evaluated with a number of farmers. In an open and participatory way, farmers reflected on the weak and strong elements of the trainings and they gave several recommendations. They adhere a lot of importance to the training. Figure 4.4 summarises the opinions of the farmers.

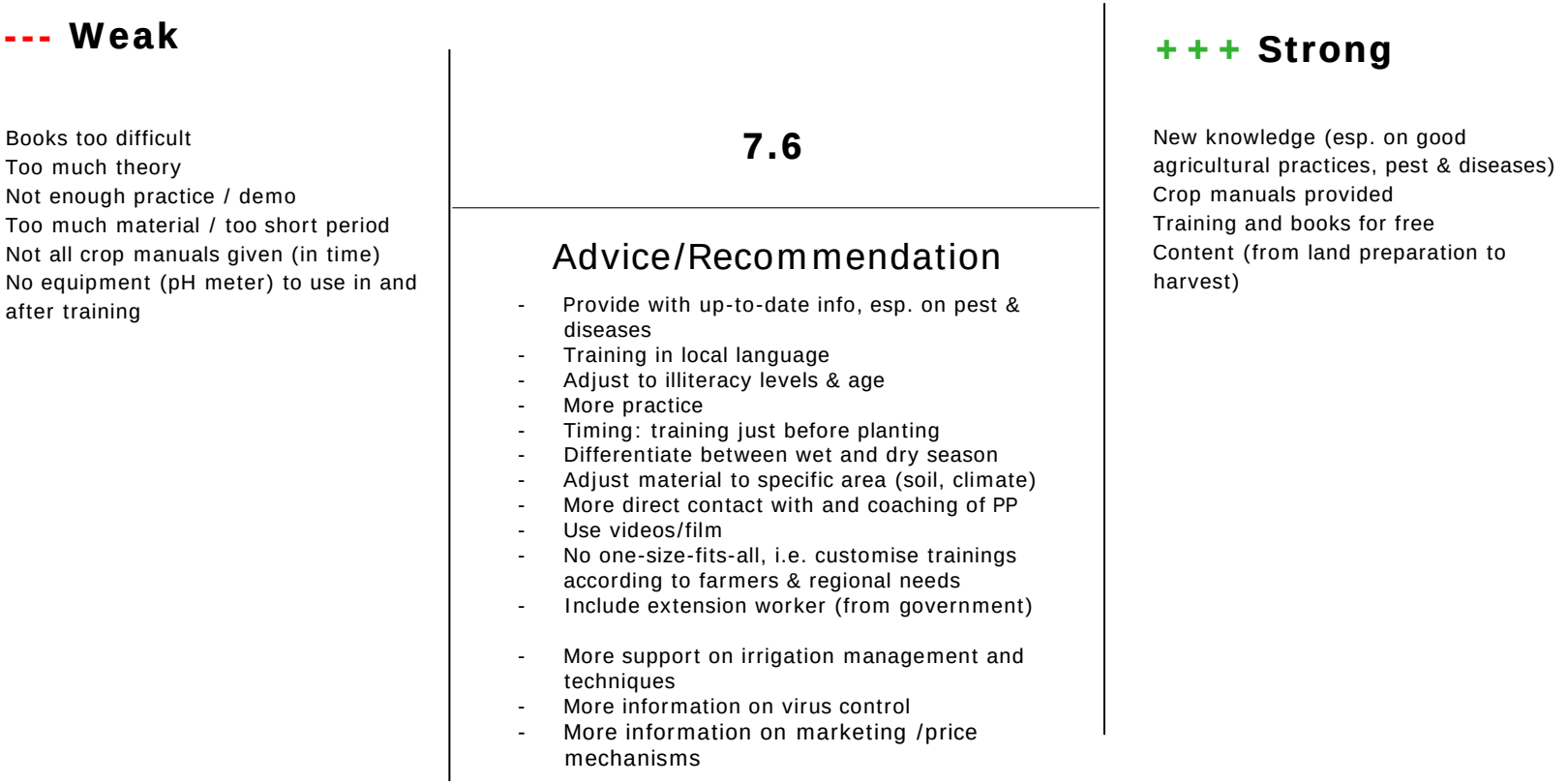

Figure 4.4 Overview of the 10 H-diagrams and average score given by the farmers

5

Immediate outcome: increased knowledge

Immediate outcome: increased knowledge on good agricultural practices

Knowledge levels, a prerequisite to change behaviour, and related practices were tested based on survey data and FDGs

We presented the respondents with some statements to test their knowledge. The same topics were formulated into questions to assess whether farmers apply the correct agricultural practice and adopt the lessons they learnt (Chapter 6). The survey focused on the following knowledge topics: the use of foliar fertiliser, frequency of spraying pesticides, spray nozzle and moment of spraying. Here, we do not distinguish between dry and wet season as the knowledge on good agricultural practices applies to both seasons. The FGD and interviews allowed for verification of the main lessons learnt. We asked the participants to spontaneously sum up the topics they could remember and what they learnt. Out of all the data, a top is made of the lessons learnt out of the training.

More than 80% of the farmers is still convinced that foliar fertilisers are needed for good growth

One of the training topics addressed the use of foliar fertilisers on crop growth as relatively expensive and ineffective inputs for farmers. There are minor changes in the knowledge on foliar fertiliser (Table 5.1). While slightly more farmers think foliar fertiliser is not needed for good growth (4.5% versus 2.6% in 2014), a larger number of farmers seems to be confused (9.8% versus 2.6% in 2014).

Table 5.1 Foliar fertilisers are needed for good growth (n=582 in 2014 and 2016)

Foliar fertilisers are needed for good growth (in %)	2014	2016
No	2.6	4.5
Yes	80.1	80.1
Sometimes	14.8	5.7
I do not know	2.6	9.8
Total	100	100

The majority of farmers learnt that spraying with four pesticides in a mix is not more effective than spraying with only one type at once

Another important knowledge item in the training was about the mixing of pesticides. Commonly, farmers mix various pesticides and farmers are convinced that this results in a better pest control than applying the pesticides in separate spray operations. However, mixing of pesticides particularly saves time and money as only one spray operation is needed. Before the training only 18% of the farmers knew that mixing is not more effective than applying pesticides separately; After the trainings this percentage was 62% (Table 5.2).

Table 5.2 Spraying four pesticides in a mix is more effective than applying four pesticides in different spray operations (n=577 in 2014 and 2016)

Spraying 4 pesticides in a mix is more effective than applying four pesticides in different spray operations (in %)	2014	2016
No	21.8	61.7
Yes	51.7	18.2
Sometimes	19.9	9.0
I do not know	6.6	11.1
Total	100	100

After the training, more farmers are aware that the quality of the nozzle influences pest and disease control

Farmers are not always aware that the nozzle affects the quality of pest and disease control, and that nozzles should be checked regularly and replaced if proven to be worn out. Before the training 66% of the farmers knew this and this percentage increased to 76%.(Table 5.3).

Table 5.3 The quality of the nozzle does not influence effective pest and disease control (n=567 in 2014 and 2016)

The quality of the nozzle does not influence effective pest and disease control (in %)	2014	2016
No	12.4	9.5
Yes	66.1	76.5
Sometimes	9.4	3.7
I do not know	12.0	10.2
Total	100	100

Farmers have learnt that pesticide spraying before it starts raining is not preferred

Spraying of pesticides when rainfall is expected shortly reduces the effectiveness of the pest or disease control measure and it negatively affects the environment. Before the training only 25% of the farmers was aware of this, while after the training 69% of the farmers knew about the negative effect of rainfall on the effectiveness of a pesticide application (Table 5.4).

Table 5.4 Pesticide spraying before it starts raining is preferred (n=537 in 2014 and 2016)

Pesticide spraying before it starts raining is preferred (in %)	2014	2016
No	24.3	69.3
Yes	56.7	20.8
Sometimes	15.5	8.4
I do not know	3.5	1.6
Total	100	100

Qualitative information confirms main learnings on integrated pest management and appropriate application of fertiliser

All farmers in the FGD and interviews were asked about what they could remember from the training and what they had learnt. The data were validated with information received from the trainers (product promotors), staff of Ewindo and the trainers who were also involved in the design of KT. The following topics were considered most instructive (in the order of importance): i) spraying techniques: direction, distance, timing, frequency; ii) mixing of pesticides (number of types / active ingredient); iii) appropriate amount of fertiliser + application of basic fertiliser; iv) pH water and soil measurement techniques; v) identification of pest and diseases; vi) appropriate doses of pesticides; vii) land preparation: basic fertiliser/planting space/seed beds. These data confirm that the changes we measured with the survey can be attributed to the training.

Barriers in knowledge transfer relate to organisation of trainings and farmers' profile

Not all envisioned knowledge has been successfully transferred. According to respondents in the FDG, this relates to broadly two levels: the farmers' characteristics and the organisation of the intervention.

At farmer level:

- Farmers are convinced of own practices applied.
- Information was too difficult because of low level of education or high age.
- Farmers did not follow all three modules.

At intervention level:

- Profile of the product promotor of Ewindo (i.e. sometimes too young, unexperienced, not from the same location as the farmers).
- Capability of the product promotor as a trainer: the product promotors are not selected as trainers or educated as a trainer; some are more talented and have more pedagogic skills than others. This can influence the quality of the training and how the information is received by farmers.
- Too many topics in a short period of time.
- Too much theory, more practice is desired.

It can be concluded that overall knowledge on agricultural practices has increased thanks to the trainings

Overall knowledge on agricultural practices has increased thanks to the KT trainings. From the survey results we can see positive changes in knowledge and the qualitative data confirm that the changes can be attributed to the trainings. In Chapter 6 we give insights into the degree farmers applied the new learnings. Now we have seen that knowledge has increased we expect that – in line with the Theory of Change - their practices are positively changed.

6

Intermediate outcome: Mixed results on adoption

Intermediate outcome: Mixed results on adoption of good practices

Enhanced knowledge on good agricultural practices should lead to change in practices: from knowledge to action

Improved agricultural practices are key immediate outcomes in the Theory of Change and as such crucial in achieving the objectives. It is assumed that good agricultural practices lead to higher productivity, lower cost prices and higher gross crop incomes. While this assumption is based on solid experimental proof, from an agro-economic point of view it only holds in case of perfect and complete uptake; something yet to be proven for the farmers targeted. This Chapter presents the changes in main agricultural practices between the baseline in 2014 and the evaluation in 2016. We focus on the same topics of Chapter 5 where knowledge changes were presented. Besides, we present results on indicators at programme level, i.e. whether a) the vegetable area increased and b) the trained farmers' production areas of hot pepper, tomato and cucumber increased. We do not distinguish between dry and wet season for knowledge on good agricultural practices applies to both seasons. The number of observations in the baseline and evaluation are the same.

The FGD and interviews allowed for verification of the main lessons learnt and the main changes in practices. We asked the participants to spontaneously mention how they changed their farming practices based on the training. Out of all the data, a top ten is made of the lessons learnt (Chapter 5) and a top of the lessons applied (current Chapter).

Overall increased vegetable area

The average farm size increased from 5,700 m^2 in 2014 to 8,300 m^2 in 2016. However, variation between farmers is very high with a standard deviation as high as the mean (data available on request). The majority of the farm area is used for vegetable production, so the vegetable area of trained farmers on average increased. But there are some differences among the seasons: the vegetable area increased in the wet season and was decreased in the dry season at the expense of non-vegetable crops. (Table 6.1). The increase in the wet season is somewhat surprising as it is in general more risky to produce vegetable crops in the wet season due to higher pest and disease pressure. However, vegetable production may be more rewarding thanks to higher prices.

Mixed results on changes in the area with the three main crops tomato, hot pepper and cucumber

The number of farmers that produce a certain crop varies by crop and season. Some farmers indicated to have produced one of these crops but omitted to share the specific cultivated area. We excluded these farmers from the analysis. Figure 6.1 and Table 6.2 show the average area with hot pepper, tomato or cucumber in the dry and wet season for 2014 and 2016. The average acreage in all crop-season combinations increased, with a significant increase for tomato production.

Table 6.1 Farm characteristics of respondents of the baseline and evaluation survey

Personal and household characteristics	Baseline	Evaluations
Average farm size in m2	5,700	8,300
Average land use dry season		
non-horticulture	6.7%	8.9%
horticulture	93.3%	91.1%
Average land use wet season		
non-horticulture	16.3%	9.6%
horticulture	83.7%	90.4%
Crops most frequently mentioned in the dry season	1. Hot pepper 2. Tomato 3. Cucumber 4. Eggplant	1. Tomato 2. Curly chili 3. Hot pepper 4. Cucumber
	1. Hot pepper 2. Tomato 3. Rice 4. Long been	1. Tomato 2. Curly chili 3. Hot pepper 4. Rice

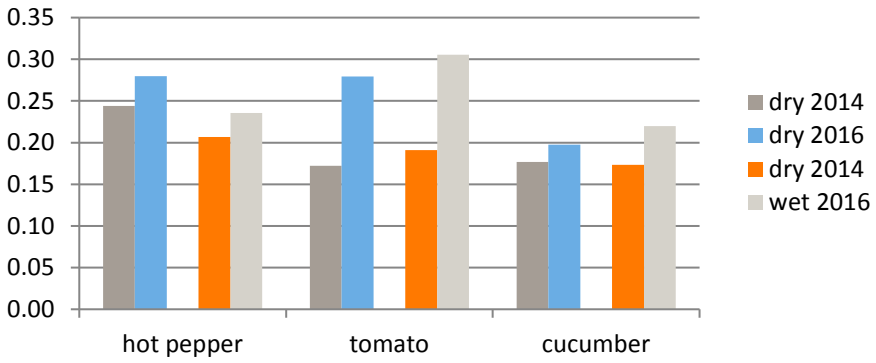

Figure 6.1 Average area (ha) of hot pepper, tomato and cucumber for dry and wet season in 2014 and 2016. Note, significant increase in tomato production in both seasons.

Table 6.2 Change in the area with the three crops (in ha) in 2014 and 2016 (*** significant)

Hot pepper dry	Obs	mean	St dev	min	max
2014	191	0.24	0.28	0.002	2.5
2016	58	0.28	0.22	0.005	1
Hot pepper wet					
2014	141	0.21	0.24	0	1.5
2016	56	0.24	0.21	0.005	1
Tomato dry * **					
2014	122	0.17	0.16	0.03	1
2016	164	0.28	0.29	0.05	2.5
Tomato wet***					
2014	102	0.19	0.20	0.005	1
2016	153	0.31	0.31	0.0002	2.5
Cucumber dry					
2014	49	0.18	0.22	0.003	1.5
2016	65	0.20	0.22	0.01	1.5
Cucumber wet					
2014	37	0.17	0.41	0	2.5
2016	49	0.22	0.21	0.01	1.4

Farmers still use foliar fertilisers

One of the training topics addressed the use of foliar fertilisers as an ineffective and relatively costly input. The percentage of farmers that did *not* use foliar fertiliser at all increased substantially from 4.7% in the baseline to 19% after the trainings (Figure 6.2 and Appendix 4 Table A4A). It seems that the trainings mainly convinced farmers that sometimes used foliar fertilisers: a large percentage of these less frequent users of foliar fertilisers stopped using them after the trainings. However, the percentage of farmers that said to always use foliar fertilisers hardly changed.

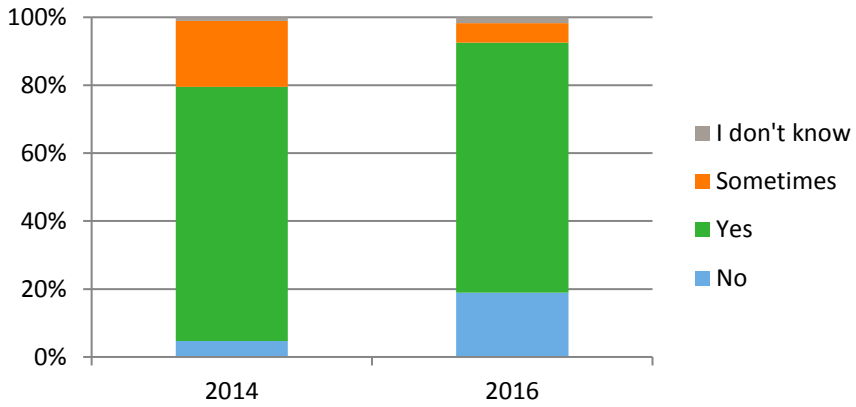

Figure 6.2 Farmer response on the question 'Do you use foliar fertilisers?' (n=575)

Less farmers mix more types of pesticides when spraying

After the trainings, relative more farmers stated not to mix four types of pesticides which is in line with the answers they gave to the knowledge question on the effectiveness of pesticide mixing (Figure 6.3 and Appendix 4 Table A4AB).

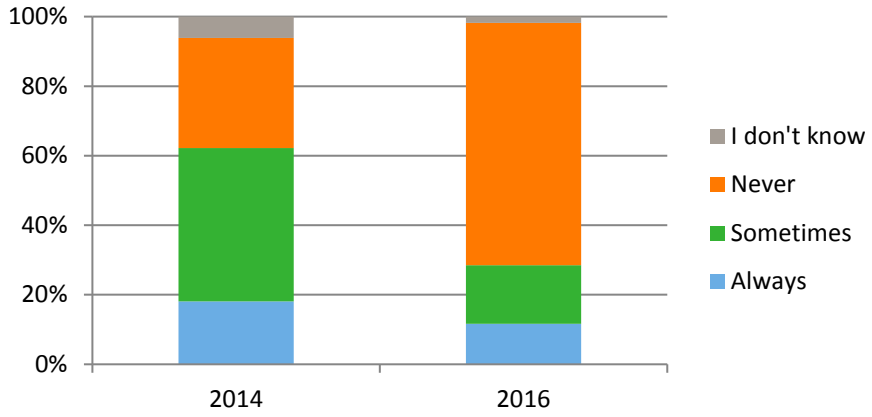

Figure 6.3 Mixing of pesticides by farmers (n=558)

More farmers replace their nozzle after the training

After the trainings farmers replaced nozzles of the sprayer more frequently than before the training, which is very important for effective spraying (Figure 6.4 Appendix 4 Table A4C).

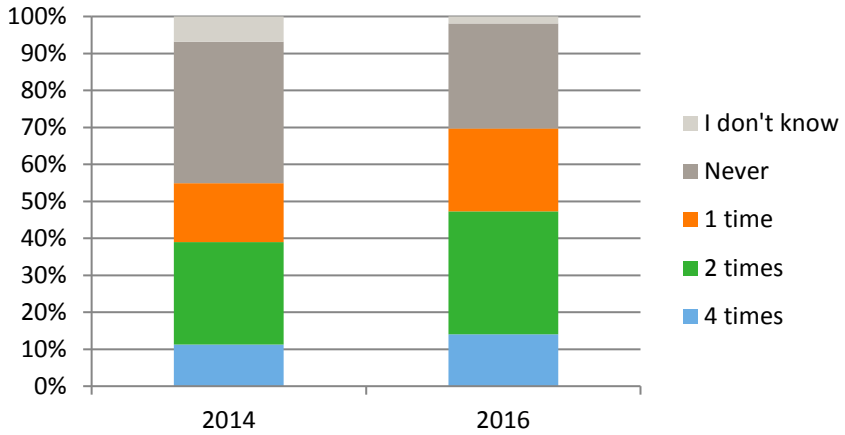

Figure 6.4 Replacement of nozzle by farmers (n=415)

Less farmers let their labourers on the field after spraying having knowledge on the dangers of pesticide

Another positive finding relates to occupational health of labourers. The trainers recommended not to enter the field just after spraying of pesticides as this may have adverse health effects. Almost 79% of the farmers indicated in 2016 that they do not allow labourers to enter the field after spraying, while this was 63% of the farmers in 2014 (Figure 6.5 and Appendix 4 Table A4D).

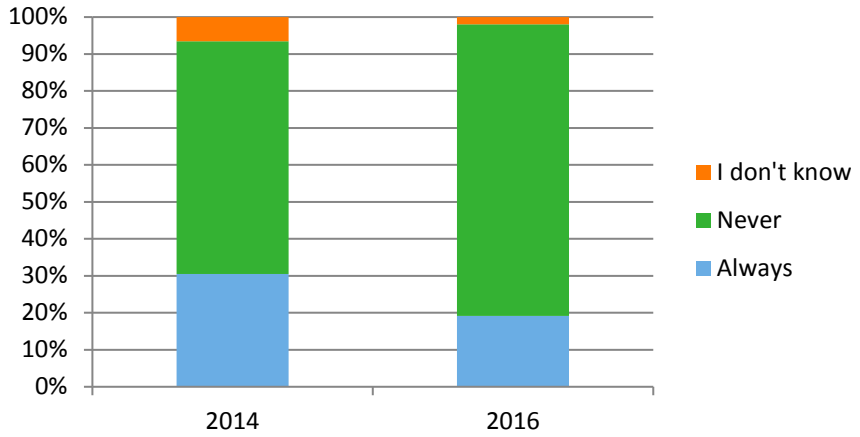

Figure 6.5 Labourers in the field after spraying with pesticides (n=554)

Increased use of Personal protective equipment (PPE)

The use of PPE in mixing and spraying pesticides is not common practice in Indonesia. The use of some form of PPE increased after the training from 15% in the baseline to 100% in the evaluation. The main PPE items used are an overall or long sleeves, a mask and hat. However, these results were not confirmed in the FGD and interviews. The majority of the farmers knows the importance of PPE but use of PPE hampers smooth work and is little practical, e.g. it is often too warm and a mask doesn't allow for smoking during the work. In addition, the majority of farmers hires workers for the spraying activity and farmers do not know whether the workers use PPE and do not motivate them do so either (Figure 6.6)

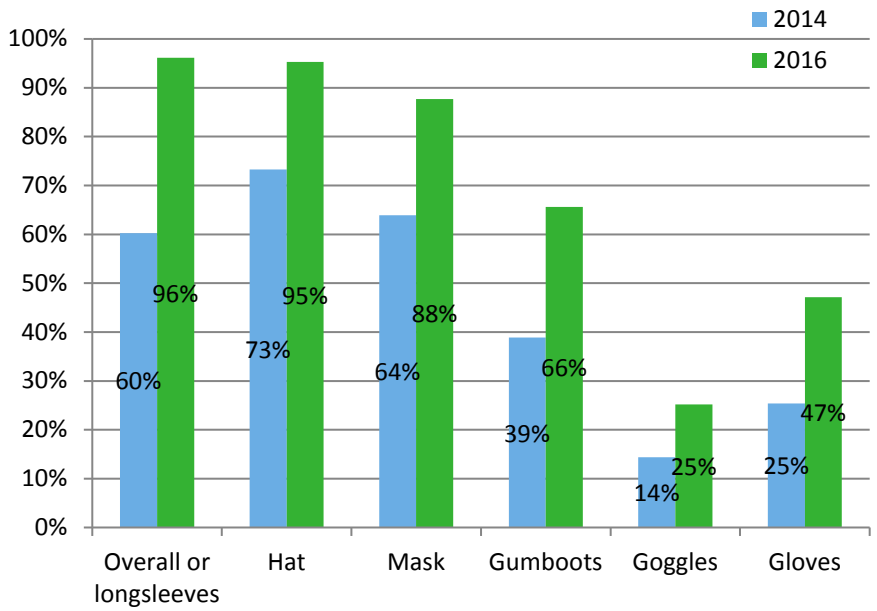

Figure 6.6 Percentage of farmers using PPE (percentages of farmers using PPE).

Reduced pain and sickness due to pesticides use

Frequent exposure to pesticides can affect human health. Farmers were asked about pain and sick days due to spraying and the use of pesticides. Results show that farmers experience less negative health effects. Also the number of sick days after spraying is reduced from 2.1 on average in 2014 to less than a day in 2016 (Tables 6.3 and 6.4). It is not obvious to relate this outcome on health to the trainings received. Mainly because the qualitative data show that farmers are somewhat reluctant to use PPE and that the majority of the farmers respondents does not apply pesticides themselves, they hire workers.

Table 6.3 Pain due to pesticide use (n=567)

Pain due to pesticides (in %)	2014	2016
Always	30.2	25.2
Sometimes	35.8	7.1
Never	32.1	66.5
I don't know	1.9	1.2
Total	100	100

Table 6.4 Sick days due to pesticide use (n=334)

Sick days due to pesticides (in %)	2014	2016
Average number of sick days	2.1	0.5

Most changes in integrated pest management and appropriate use of fertiliser, less on pH water and soil management and appropriate doses of pesticides

Table 6.5 shows a top 10 of learnings and applications of GAP based on information from the FGD and interviews. It confirms quantitative data on the importance of the knowledge and the adoption of new practices related to spraying techniques, mixing of pesticides and the correct use of fertiliser. Contradictory to the survey data are the findings on the use of PPE. This was mentioned only six times as a learning topic and only five groups farmers applied the recommendations on the use of PPE. Another GAP frequently mentioned was that farmers gained new knowledge on the pH of water and soil and that pH meters exist to measure it. However, most farmers do not have pH meters and are not willing or able to purchase these meters. Some product promotors have a meter, which is used by farmers. Some better organised farmer groups collectively bought a pH meter after the trainings.

Mixed results on adoption of learnings

While some farmers are able to understand the knowledge and apply it, leading to positive results, others find it too difficult and are not able and built enough

to apply. The following two quotes of farmers from different farmer groups who received KT training illustrate this.

> 'Before the training we only used one pesticide, always the same, every year. Now we try to apply the right pesticide for a specific kind of disease we first try to identify. And we have higher yields now and less diseases.'

> 'We tried to follow the recommendations for pest & disease control but it was too difficult. We cannot manage to do so. It is hard to remember all that was explained in the training, we cannot read the books, nor the explanations on the flacons itself. The training was too short, too difficult and the books are too difficult.'

Table 6.5 GAP lessons and adoption based on FGD and interviews

Immediate and intermediate outcome levels	Learning	Applications
Spraying techniques: direction, distance, timing, frequency	13	13
Mixing of pesticides (number of types / active ingredient)	11	8
Appropriate amount of fertiliser + application of basic fertiliser	10	8
pH water and soil measurement techniques	10	4
Identification of pest and diseases	9	8
Appropriatie doses of pesticides	9	6
Land preparation: basic fertiliser/ planting space / seed beds	6	5
Importance of PPE	5	3
Rotation schedule	1	1
Use of plastic	2	0

Still room for improvement of agricultural practices

The survey results are quite positive when it comes to knowledge gained as well as adoption. However, Table 6.5 and insights from the FGD and interviews reveal that not all new knowledge is applied and that the current agricultural practices still leave a lot of room for improvement.

Limited adoption due lack of knowledge transfer, distrust and risk averseness of farmers and external influences

Not all information of the trainings has successfully reached the farmers while implementation of other recommendations appeared impractical, unavailable or inaccessible for farmers. Lessons which have not been (sufficiently) transferred cannot be practiced. Not all farmers are convinced or are able to absorb, and embrace the new knowledge. This has to do with their personal characteristics but also to external influences and dynamics. Individual characteristics like gender, age, education, firm size, wealth and proximity to the market and being member of a farmer group could lead to differences in the uptake of improved practices. For the latter, also so-called front-runners (i.e. the early adopters) can play an important role in the adoption of new technologies (Meijer et al. 2015, NR International 2000). In addition, the adoption of most GAP is commonly understood as investment decisions that require capital and labour resources and access to knowledge, information and training. Such investment decisions are guided by perceived risk, while many poor farmers are risk-aversive (Barham et al. 2014; Feder et al. 1985). The analysis of behavioural drivers for investments should also distinguish between risk attitudes for particular types of practices, thus anticipating different uptake rhythms by specific types of producers (Ruben 2017).

Farmers are experienced and somewhat sceptical to new knowledge

In addition, we have seen that farmers are on average experienced farmers in horticulture, approximately 7-8 years. They are somewhat sceptical towards new knowledge and are convinced of their experience as a farmer. Their scepticism even increases when confronted with various interventions providing support or other programmes for agricultural development.

Personal and cultural influences hampering adoption

Other explanations can be found in more general characteristics of rural smallholder farmers which are relatively poor. They are in general risk-averse hampering change and they have a short time horizon. There are also cultural and external factors which affect adoption such as i) the presence of active pesticide agents promoting their products and rewarding purchases, ii) extension officers with low levels of expertise and knowledge of good agricultural practices and thus can provide little support to farmers facing problems with the implementation of new technology, iii) unfavourable climatological conditions and a country-wide habit of smoking demotivating the use of PPE.

7

Ultimate outcome: Positive changes

Ultimate outcome: Positive change in productivity and earnings

Improved agricultural practices are to reduce costs and increase quality and productivity

Following the intervention logic (Figure 2.1), adoption of good agricultural practices and better input use are the intermediate outcomes of the intervention leading to the ultimate outcome of higher crop productivity, lower production cost, and higher quality and price for the crops. For many ultimate outcome variables we have limited overlap of farmers producing the same crop in the same season in both years. For example only 13 farmers produce hot pepper in the wet season in both years while 125 and 38 farmers produce it in one of these years. This means that we either show mean values for a very small subset of farmers or we present data on a different group of farmers in both years. We consider the second option to be better because it gives a more realistic picture (as changing crops over year is a common practice) and allows us to get a more representative picture. In Appendix 5 and summarised in Table 7.7 we present the results of the same farmers producing the *same crop* in 2014 and 2016 in the same season. For the dry season, the results for the same farmers show the same trend as the results at group level as presented in this chapter. For the wet season though, there are some different observations in the dry season between the same farmers and the farmer group averages on the variables productivity, price and earnings of hot pepper and cucumber production. Due to the small number of observations it impossible to state whether differences are significant.

Significant decrease in tomato productivity in the wet season

The change in productivity differs per season and per crop. The only significant difference is in tomato productivity in the wet season: yields were lower in the evaluation. Where average productivity was more than 43,000 kg per ha in 2014, it was only approximately 26,000 kg/ha in 2016. More farmers cultivated tomato in the wet season in 2016 but they did not improve their productivity. We see a different picture though for the same farmers producing tomato in the wet season in 2014 as well as in 2016 (n=35): they did improve their productivity (but we don't know if they did so significantly). A plausible argument is that the farmers who already produced were more experienced and improved after the training. The farmers who started to produce tomato in 2016 were not (very) experienced in tomato cultivation and as such did not achieve high productivity. Although the changes of cucumber in the dry season and hot pepper in the wet season are considerable, the differences were not significant (Figure 7.1 and Appendix 4 Table A4E).

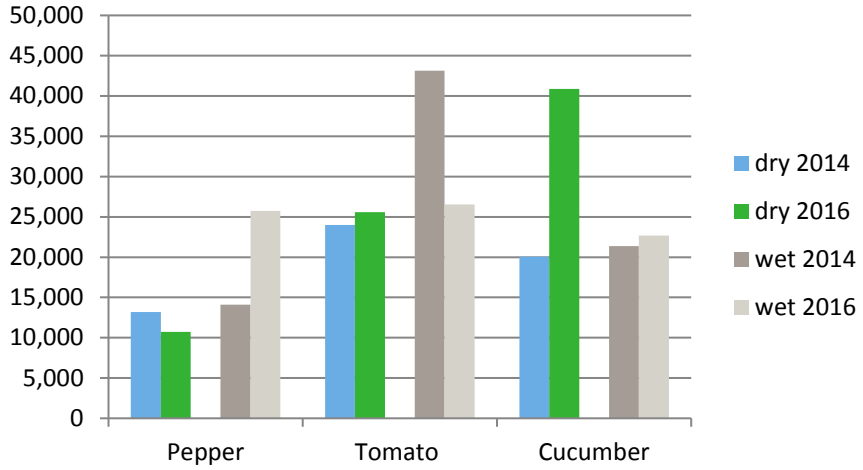

Figure 7.1 Productivity (in kg/ha) of hot pepper, tomato, cucumber in the dry and wet season of 2014 and 2016

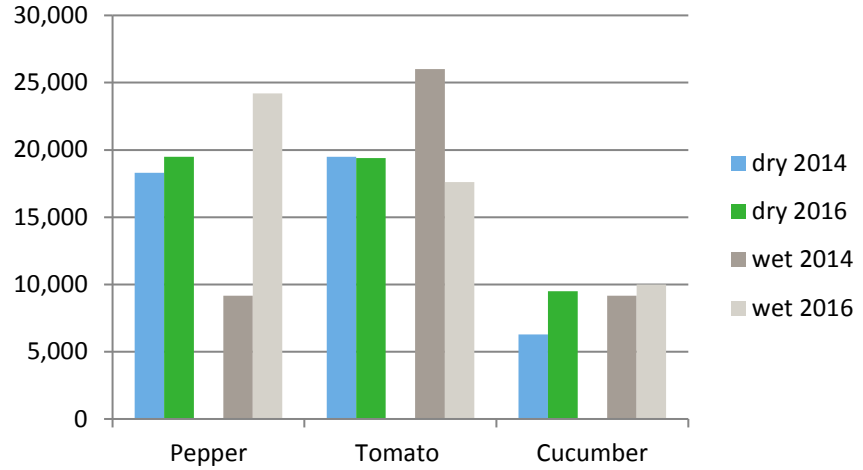

Figure 7.2 Production costs in IDR[5]/ha (*1,000) hot pepper, tomato, cucumber, dry and wet season 2014 and 2016

Significant decrease in tomato production costs (in the wet season only), not for cucumber and hot pepper

Production costs per ha in both seasons for hot pepper and cucumber increased after the trainings, but not significantly. Only for tomato production, the costs in the wet season decreased significantly. Not one specific input caused the change in costs: all input costs decreased considerably. It is unknown whether the increase or decrease is caused by the purchase of more or less inputs or whether the prices of inputs increased or decreased over the years. We asked for input costs and not for input use. It is remarkable that the lower tomato productivity in the wet season coincides with lower production costs. It could be that there is a relation and that the volumes of inputs used were not correct or that the quality was below a certain standard to guarantee for higher productivity. Production costs are highest for tomato and hot pepper; cucumber has relatively low production costs (Figure 7.2 and Appendix 4 Table A4F).

Farmers received a lower price for cucumber in the dry season, no significant change for tomato or hot pepper

The average price received for hot pepper increased (but not significantly) in the dry season from approximately IDR 15,000 to 18,000 per kg and remained approximately the same in the wet season. For tomato, the average price slightly increased in the dry season but remained unchanged in the wet season. The price for cucumber decreased in both seasons with a significant decrease in the dry season. Appendix 4 presents the minimum, maximum and standard deviations of product prices. There is high variation in prices received by farmers (even after excluding the outliers) which can be related - to among others - regional differences in Indonesia (Figure 7.3 and Appendix 4 Table A4G).

[5] IDR: Indonesian currency

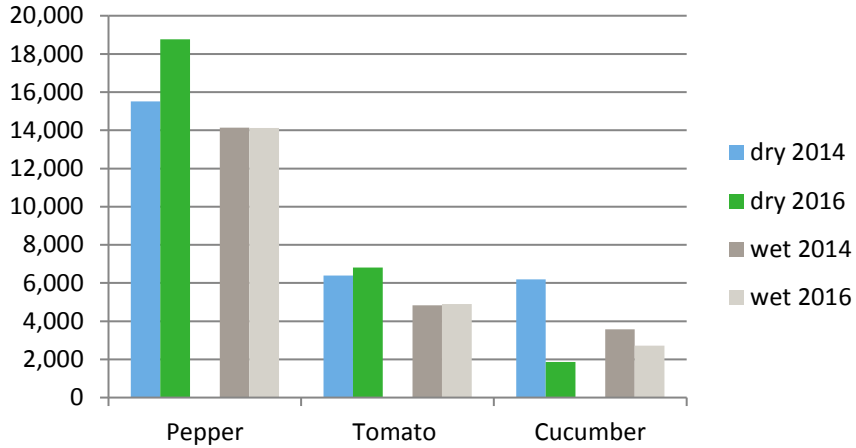

Figure 7.3 Average price received in IDR/kg per crop, season and year

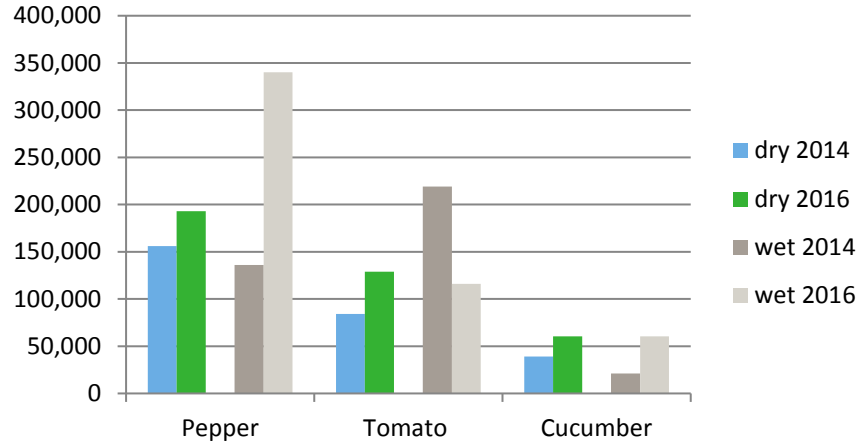

Figure 7.4 Average earnings in IDR (*1,000) per crop, season and year

Average earnings decreased significantly for tomato (in the wet season), not for cucumber and hot pepper

The average farmer earnings in IDR per ha of hot pepper increased both in the dry and the wet season, but not significantly (Figure 7.4 and Appendix 4 table A4H). The farmer earnings also increased (but not significantly different) for tomato in the dry season and for cucumber in both seasons. There is a significant decrease in tomato earnings in the wet season which is related to a decrease in productivity. The increased earnings for tomato in the dry season is mainly related to an increase in price. For cucumber, prices decreased so an increase in earnings is related to higher productivity. For hot pepper the increase in farm earnings in the dry season is related to an increase in price as yields decreased (Figure 7.1). Hot pepper prices in the wet season remained more or less the same but productivity increased considerably, resulting in considerably higher earnings (Figure 7.1).

No significant changes in average margins of all crop-season combination

An increase in financial margin is no formal objective in the ToC because of the high volatility of market prices. We do however present the results, as financial margins are an important factor for farmers in farm management decisions. Farmers reported higher margins for hot pepper and cucumber in both seasons, and for tomato in the dry season. The largest increase of margin for hot pepper in the wet season is mainly attributed to higher productivity while the significant decrease of margins for tomato in the wet season is attributed to lower productivity. As such, average margins of most crop-season combinations increased, however, most changes are not significant (Figure 7.5 and Appendix 4 Table A4I).

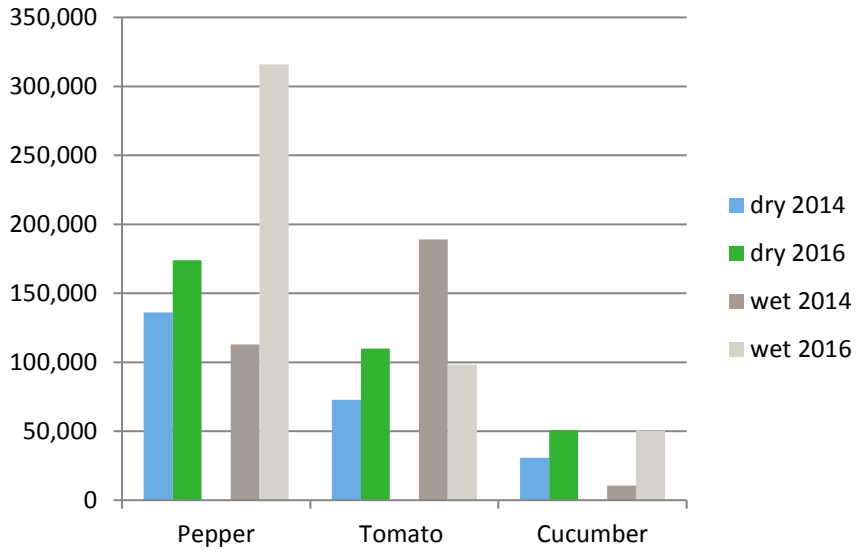

Figure 7.5 Average margin in IDR/ha (*1,000) and observations (n) per season, per year and per crop

On average, positive results but no shocking changes

Table 7.5 (group averages) and 7.6 (same farmers) give a summary of the changes at the main ultimate outcome variables. Table A4J of Appendix 4 presents the detailed results on the ultimate outcome level. A positive change is marked with a +, a negative with a -, and an * is added in if the difference between the two years is significant. The tables show positive as well as negative indicator changes with variation between season and crop. Most striking changes:

- An increase in average acreage cultivated with the three vegetable crops hot pepper, tomato and cucumber.
- A significant decrease in tomato productivity in the wet season.
- A significant decrease in tomato production costs (in the wet season only), but not for cucumber and hot pepper.
- Farmers received a lower price for cucumber in the dry season, but there were no significant price changes for tomato or hot pepper.
- Average crop earnings decreased significantly for tomato (in the wet season), not for cucumber and hot pepper.

Table 7.5 Summary survey results at farmer group level per season on ultimate outcome level (0= no change, + = increase, - = decrease, * = difference is significant)

Group farmers	Dry season					
	Area	Yield	Price	Earnings	Production costs	Margin
H. Pepper	+	-	+	+	+	+
Tomato	+*	+	+	+	-	+
Cucumber	+	+	-*	+	+	+
	Wet season					
	Area	Yield	Price	Earnings	Production costs	Margin
H. Pepper	+	+	0	+	+	+
Tomato	+*	-*	0	-*	-*	-*
Cucumber	+	+	-	+	+	+

Table 7.6 summarises the changes for the same farmers and the differences between the farmer groups and the same farmers become clear in the wet season: productivity for all crops, price of tomato and cucumber, earnings and margin for hot pepper and tomato. The dry season results show the same trend for the group averages and the same farmers. The differences in the wet season are hard to explain in a plausible manner as differences vary per crop, per variable and in direction (increase or decrease).

Table 7.6 Summary survey results for the *same* farmers per season on ultimate outcome level (+ = increase, - = decrease, red = different with Table 7.5)

Same farmers	Dry season					
	Area	Yield/ha	Price	Earnings	Production costs	Margin
H. Pepper	+	-	+	+	+	+
Tomato	+	+	+	+	-	+
Cucumber	+	+	-	+	+	+
	Wet season					
	Area	Yield/ha	Price	Earnings	Production costs	Margin
H. Pepper	+	-	+	-	+	-
Tomato	+	+	+	+	-	+
Cucumber	+	-	+	+	+	+

Mixed results on productivity and earnings from FGD and interviews

Production costs, yields, earnings and margins were also important topics in the FGDs and the interviews. There was consensus among farmers that production costs had decreased in the dry season but increased in the wet season. Farmers unanimously indicated that it is too risky to use fewer pesticides in the wet season. However, opinions of farmers on yield changes and prices varied. In general, the farmers follow market prices, i.e. they all start to produce the same crop when the price is high, resulting in oversupply at harvest and consequently low market prices.

Various reasons for somewhat limited effects at ultimate outcome level

There are various plausible explanations why the effect of trainings on the *(i.e. yield, cost price, reduced pesticide and fertiliser use, and area expansion)* is somewhat limited. The first remark is in line with the intervention logic. We have seen that not all farmers apply the lessons learnt and adopt all GAP. Significant and meaningful changes on productivity and reduced production costs can therefore not be expected.

Highly fluctuating market prices of horticulture undermine potential programme impact

Other plausible explanations in addition to the intervention logic can be found in external influences and assumptions beneath the theory of change. One such external influence which was already stipulated in the previous paragraph relates to market prices of horticulture which fluctuate considerably. While the governmental regulation on rice prices, horticulture lacks any regulation. In addition, the government still favours rice cultivation of price by subsidies of rice inputs.

Unpredictable weather, climate change and risk of pest and diseases outbreaks are important limiting factors

Another important contextual factor which explains limited changes can be found in climate change. Although Indonesia knows two seasons, the wet and dry season, the weather is becoming very unpredictable, making it very challenging to farm. And every season has its own challenges. The main challenge in the dry season is irrigation and for the wet season the risk of pest and diseases. There is also always the risk of a (new) pest and disease outbreak, especially in the wet season and there is not always an up-to-date expertise on the correct treatment strategy.

8

Conclusions & Recommendations

Conclusions & Recommendations

Study on effects and success of vegIMPACT Knowledge Transfer

This study assessed the effects of the work package Knowledge Transfer (KT) of vegIMPACT Indonesia. The programme trained farmers across Indonesia on improved and safe tomato, hot pepper and cucumber production.

The intervention logic was geared to increasing the knowledge through a three-day training course with different modules introducing good agriculture practices (GAP). The trainings were aimed at improving production practices including responsible use of crop protection agents and PPE, resulting in improved yields and lower production costs. This study did not analyse the impact of the trainings on improved food security and improved competitiveness of Indonesian farmers. Effects were measured with a mixed-method approach. A sample of targeted farmers has been approached via a quantitative baseline (1,858 farmers) and evaluation survey (665 farmers). The survey was complemented with 16 FGDs covering different regions of Indonesia and with 10 in-depth interviews with relevant stakeholders.

Table 8.1 Summary survey results per season on ultimate outcome level (0= no change, + = increase, - = decrease *=significant change)

	Dry season					
	Area	Prod.	Price	Earnings	Production costs	Margin
H. Pepper	+	-	+	+	+	+
Tomato	+*	+	+	+	-	+
Cucumber	+	+	-*	+	+	+
	Wet season					
	Area	Prod.	Price	Earnings	Production costs	Margin
H. Pepper	+	+	0	+	+	+
Tomato	+*	-*	0	-*	-*	-*
Cucumber	+	+	-	+	+	+

More than 10,000 farmers received a complete training

At the end of 2014 107 trainers started to train the farmers in the Training of farmers (ToF) on the three modules. At the end of the intervention, module 1 was followed by 11,602 farmers; module 1 + 2 by 10,834 farmers and module 1, 2 + 3 by 10,185 farmers (Figure 4.1 and 4.2 and Table 4.1). Not all farmers followed the three modules. No in-depth research is done to explain why farmers do not complete the training. According to Ewindo these farmers lost interest and had other priorities. The majority of trained farmers was male (86%). Female participation differed by region, with the highest participation in North Sumatra and the YBTS regions (including West Papua and the Moluccas).

Farmers give an average score of 7.6 (on a 1-10 scale) for the trainings

Farmers anonymously gave a score to the intervention in general. Their average score was 7.6 on a of range 1-10 with 10 being the highest score. In general, farmers underscore the importance of the trainings as it provided access to new and up-to-date agricultural knowledge. A weak point of the trainings was that they contained too much information that was dealt with in a short period of time and that the majority perceived the reference books too difficult.

Mixed results on changes in productivity, earnings and margins

Table 8.1 gives an overview of the KT objectives. The table shows there is variation between seasons and crops and it is therefore not possible to draw one conclusion on the KT ultimate outcome level. In general though, the review shows quite favourable changes especially with regard to production costs and margins. However, the positive changes are not significant. The major negative changes are in the tomato production in the wet season: results show a significant decrease in productivity and earnings although production costs decreased. The other negative significant change is the decrease in price received for cucumber in the dry season.

Reasoned from the theory of change: limited adoption means limited impact

There are various plausible explanations of the mixed effect of the trainings on the objectives *(i.e. yield, cost price, reduced pesticide and fertiliser use, and area expansion)*. The first remark is in line with the intervention logic; knowledge which have not been (sufficiently) transferred cannot be practiced. Second, we have seen that - for various reasons - not all farmers apply the lessons learnt and adopt the good agricultural practices. Significant and meaningful changes on productivity and reduced production costs can therefore not be expected. In the following paragraphs we elaborate on the limitations of the KT-ToC in the Indonesian context and point at plausible explanations why the effect of trainings is limited.

Barriers in knowledge transfer relate to organisation of trainings and farmers' profile

According to respondents, the reasons why not all envisioned knowledge has been successfully transferred relates to broadly two levels: the farmers' characteristics and the organisation of the intervention.

At farmer level:

- Farmers are convinced of own practices. We have seen that farmers are on average experienced farmers in horticulture, approximately 7-8 years. They are somewhat sceptical towards new knowledge and are convinced of their experience as a farmer. Their scepticism even increased in the presence of interventions providing support or other programmes for agricultural development.
- Information was too difficult because of the low ability to acquire knowledge.
- Farmers did not follow all three modules and/or did not receive the reference manuals.

At intervention level:

- Profile of the product promotor of Ewindo (i.e. sometimes too young, unexperienced, not from the same location as the farmers).
- Capability of the product promotor as a trainer: the product promotors are no natural trainers and neither educated as a trainer; some are more talented and have more pedagogic skills than others. This can influence the quality of the training and the amount of knowledge transferred.
- Too many topics in a short period of time.
- Too much theory, more practice is desired.

Table 8.2 Overview KT Objectives and conclusions

Indicators KT	Conclusion
Increased vegetable area	Yes for all crops in both seasons
Increased vegetable productivity	Yields of four of the six crop-season combinations increased
Reduced pesticide use per unit product	unknown, but indication that less pesticides are applied in the dry season
Reduced nitrogen fertiliser use per unit product	unknown but indication that farmers are more aware of the correct volumes to apply
Reduced production costs per hectare	Total production costs increased for most crop and season combinations except for tomato dry season
Reduced occupational health problems and risk	Survey data shows that farmers use more PPE and report less pesticide-related health problems; qualitative data give less positive results

From knowledge and awareness to practice: limitations in uptake

Not all farmers are convinced of the training and/or bring the acquired new knowledge into practice. This has to do with their personal characteristics but also with external influences and dynamics. Earlier relevant studies and theories reveal that individual characteristics like gender, age, education, firm size, wealth and proximity to the market and being member of a farmer group result in differences in the uptake of improved practices. For the latter, if the farmer group is loosely organised and there are no front runners motivating

others (i.e. the early adopters), farmers may not change current practices easily (Meijer et al 2015, NR International 2000). In addition, the adoption of good agricultural production practices is commonly understood as an investment decision that requires capital and labour resources and access to knowledge, information and training. These investment decisions are mainly guided by perceived risk (Barham et al. 2014; Feder et al. 1985) and in general, smallholder farmers are risk-averse (Ruben 2017).

The FGD and interviews also revealed specific contextual and cultural reasons which have negatively influence a change in behaviour. These reasons relate to i) the presence of very active pesticide agents promoting their products and rewarding purchases, ii) extension officers with low levels of expertise and knowledge of good agricultural practices, which farmers cannot consult if they have questions or face problems during implementation of acquired knowledge iii) hot temperatures and a country wide habit of smoking demotivating the use of PPE.

Highly fluctuating market prices of horticulture undermine programme impact

Other plausible explanations of limited knowledge uptake are external influences and assumptions, which are also acknowledged in the theory of change. One such external influence relates to market prices of horticultural products which fluctuate typically. While the government regulates rice prices, horticulture lacks any regulation. In addition, the government still favours rice production by subsidising rice inputs.

Unpredictable weather, climate change and risk of pest and diseases outbreaks are important limiting factors

Another important contextual factor can be found in climate change. Although Indonesia knows two seasons - the wet and dry season – the weather is becoming increasingly unpredictable, making horticultural production more challenging. Every season has its own challenges. The main challenge in the dry season is water availability and for the wet season the risk of pest and diseases. There is also always the risk of a (new) pest and disease outbreak, especially in the wet season and there is not always an up-to-date expertise on the correct treatment strategy. New information and decision-support tools are required to help farmers to deal with more variable seasonal weather conditions.

Recommendations and lessons learnt

Although the results at different result levels of the Theory of Change are quite favourable, the intervention can be improved for more success. Based on all the data collected, the lessons learnt are captured in the following paragraphs.

Quantity versus quality

The target of training 10,000 farmers was realised by quite a margin. The implementers acknowledged that quality could be at risk when there is too much focus on the number of farmers. The country-wide organisation and monitoring of such trainings is labour-intensive, resource-demanding and complex in a country that is that large as Indonesia, diverse in cultures, and varied in agro-ecosystems. Preferably the content of the trainings is targeted at the location-specific production conditions of the farmers, which requires careful consideration of the generic training modules used in KT. Hence, there is a trade-off between reaching large number of beneficiaries and the quality of offered services.

Less is more, balance theory and practice

Closely related to the previous point is the need to focus on a number of topics and to teach by repetition, i.e. less is more. Another important recommendation is that farmers prefer to learn in practice and with less theory. Theory and practice should be balanced. Some farmers are illiterate and are not able to read the materials and reference manuals.

Who to approach: what are criteria of farmers to target

The trainers (product promoters) were not instructed or guided in selecting the farmers for the trainings. Obviously, the composition of the trained farmers has consequences for the training material and means of knowledge transfer, but also for the objectives of knowledge transfer. Farmers with little experience in producing vegetables need different information than well-experienced vegetable farmers. Alternatively, illiterate farmers need different trainings methods than literate farmers. A general recommendation is to think about selection criteria for participating farmers to end up with a more homogenous group. Such criteria can differ across locations as long as the variation within groups is minimised facilitating knowledge transfer.

No one-size-fits-all approach in Indonesia

The same KT intervention is applied all over Indonesia. Each island or region is unique in terms of agricultural practices, culture, socio-economic and institutional conditions, environment, farmer group dynamics, politics and market prices and politics. It is therefore a challenge to apply one single knowledge dissemination model across Indonesia as literacy levels vary, farmers face different cultivation problems and have different needs. Although resource intensive, a more tailor-made model should be designed for maximum and sustainable impact.

Align and balance objectives company and foundation

It is important for Ewindo and YBTS to balance and align their targets of increased sales (Ewindo) and outreach of farmers (YBTS). The focus of KT trainings were the main selling regions of the company. It is recommended that the company and the foundation have a common strategy. Monitoring and continued guidance of trained farmers is very important for sustainable results. The trainers, the product promotors, currently lack time and resources to follow up on the provided trainings. An option could be to limit the number of farmers that product promoters are supposed to train so that guidance after the trainings can be guaranteed. Another recommendation is to strengthen the organisational structure of the knowledge transfer activities. It could be worthwhile to reconsider the internal communication structures between Ewindo and YBTS and to allow the foundation YBTS to have direct communication with and coaching of the product promotors being targeted in the ToF.

Refreshment of trainers and up-to-date knowledge

The farmers as well as the trainers all agree that it is crucial that the trainings are refreshed, especially with respect to pest and disease management. Product promoters indicated that learning is a repetitive process and that farmers need coaching for a longer period to convince them a) of the new knowledge and b) to build capacity so that farmers can experiment with obtained knowledge. However, currently, the product promotors lack the time to follow up on the farmers they have trained. They have responsibility for a large number of farmers in their sales area and do not have the time and means to advise the trained farmers and to monitor them. All respondents expressed that it is very important to have up-to-date knowledge. The information and crop manuals are also available through the Internet or a mobile (MyAgri) app. However, the majority of farmers and product promotors do not have access to or do not use the Internet or a smartphone at this moment. They are also not aware of any internet or mobile service providing them with information.

The model of KT is potentially sustainable

The design of KT is potentially sustainable as KT is implemented by a local well-established commercial company and its foundation. The intervention does not only aim at providing support to farmers but the company has its own interests and benefits from success of the programme, namely more seed sales. This is a very important element in the sustainability of an intervention and success in the long run. However, to make this more successful, the recommendations mentioned before should be incorporated. In addition to that, there is a need to reflect on collaboration with more local partners like the government and IVEGRI.

Evaluation methodology effective and meaningful but with room for improvement

The applied mixed method provides good and valid insights on the uptake of knowledge and practises, and thus the ToC of the KT work package of vegIMPACT. However, the methodology has some limitations and recommendations are given to improve evaluation measurements in future similar interventions.

- The pipeline approach in order to create an internal counterfactual but a concrete planning of out roll of the intervention before the start is prerequisite.
- The product promotors, the trainers, were given freedom to select their trainees. There was no clear selection strategy or definition of farmers to be trained. Because we did not have data on personal and farm characteristics for each respondent we could not indicate how representative results are. These data should be included in future research endeavours.
- It is recommended to make use of the existing structures and communication structures of Ewindo to collect data. Ewindo field staff should keep records and communicate closely with the evaluation

team. Especially a track record of seed sales of the three crops in the areas of the intervention will give important information on whether farmers indeed use more quality seed and whether production (area) increases.

- There should be less focus on ultimate outcomes (e.g. yield, costs) and more on agricultural practices itself, on satisfaction with training and results of farmers' perception on changing yields and profit because farmers are not used to monitor and record such data. The qualitative information provides crucial insights in the mechanisms and it factors hampering or enabling positive change.

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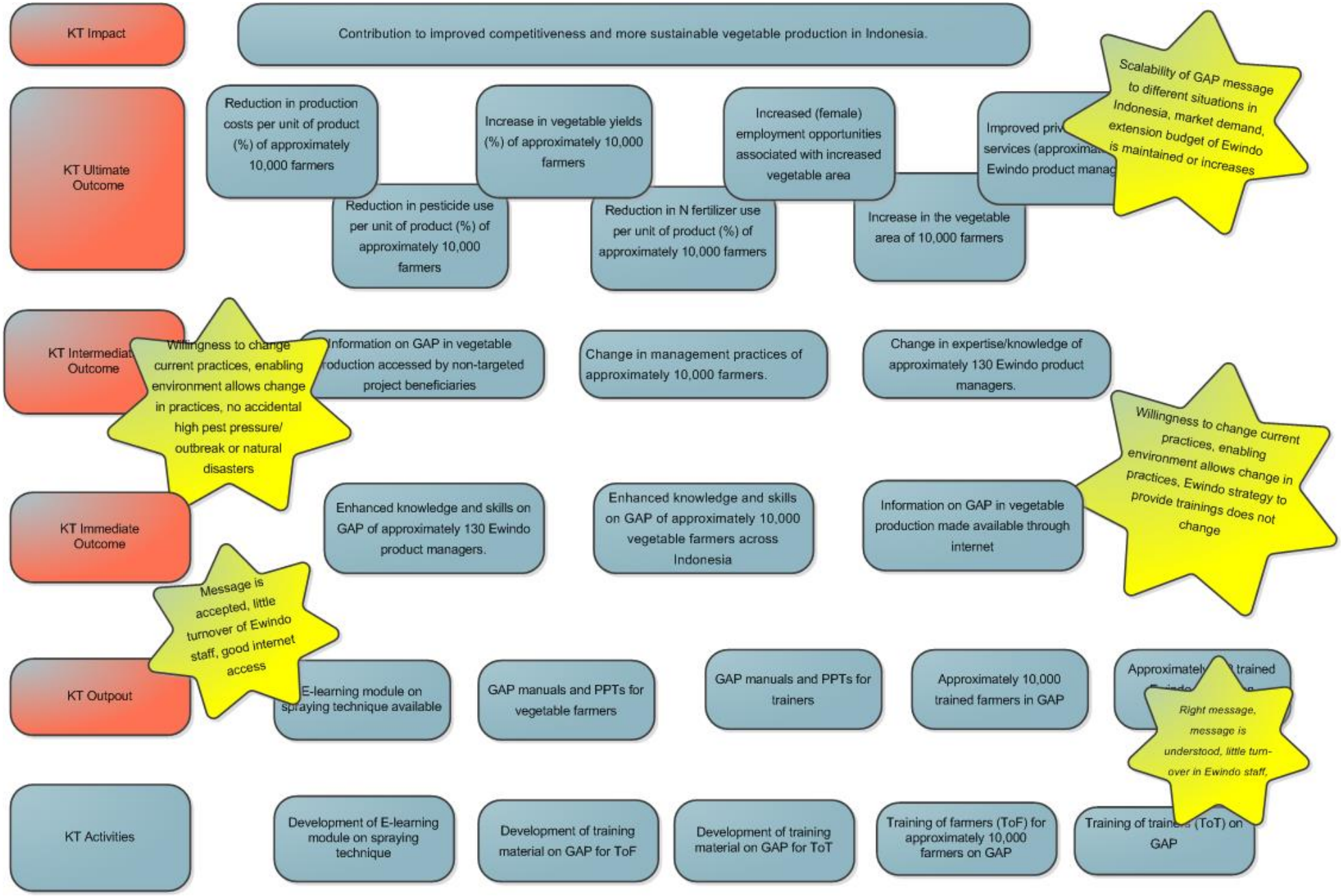
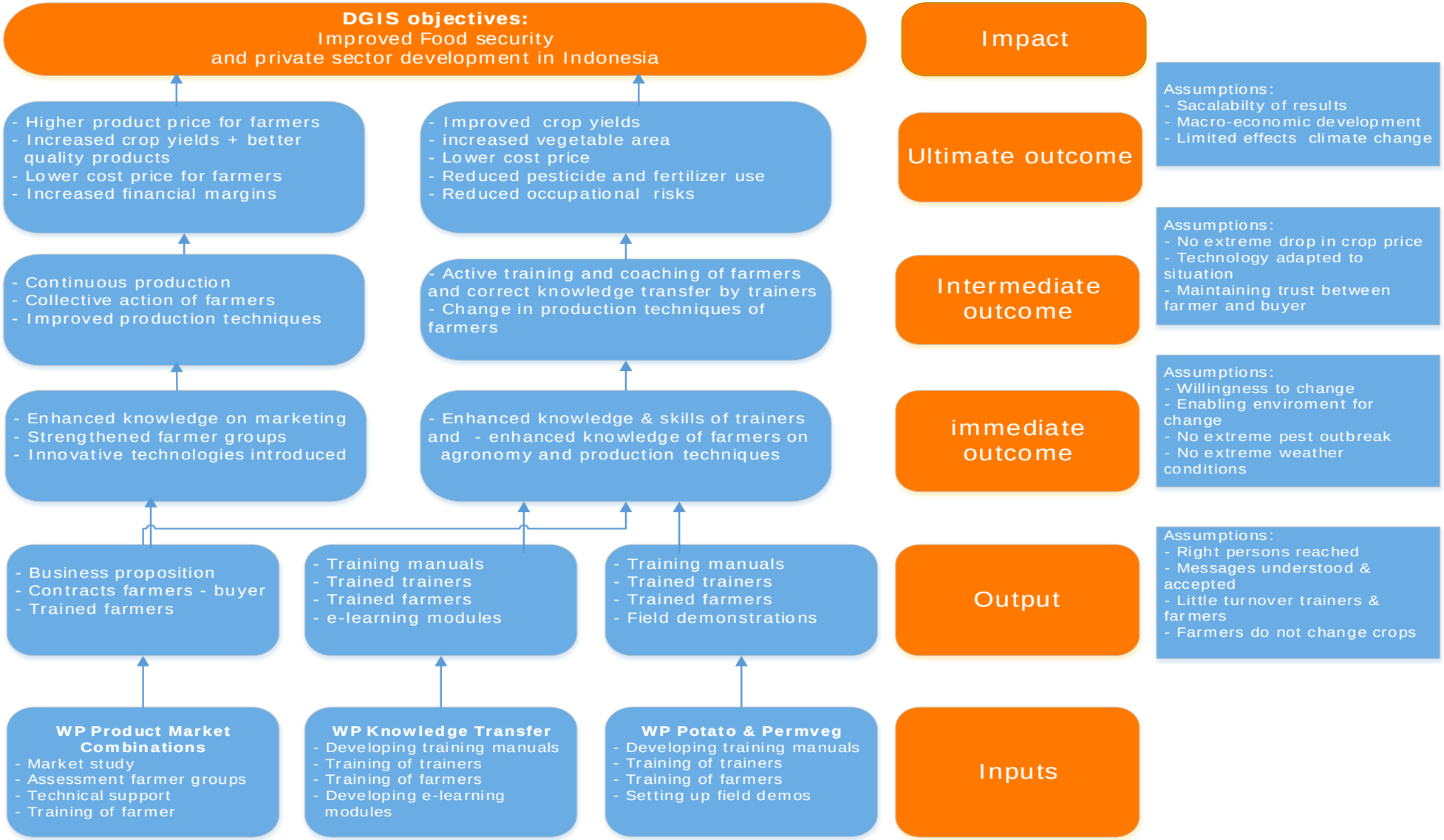
Appendices

Appendix 1a Theory of Change Knowledge Transfer



Appendix 1b Theory of Change vegIMPACT



Appendix 2 Survey format

Intake Survey

Date: .....

Introduction

1.Name:	.....	o **Male**	o **Female**
2.Village/sub district:	.....		
3.Phone number:	.....		
4. Are you pleased to be contacted by phone do you have:	o Yes o No o Whenever		
5. Age:	..... Years		
6.Your highest level of finished education	o None o Elementary school o Middle school o Senior high school o Other		
7.How many years do you cultivate vegetables	.....of years		
8. What is the size of your household?	.....people		

9.Position in a farmer group

- o Leader
- o Member of a farmer group
- o Not a member of a farmer group

10. Estimated size of your farm, including other crops?

....m2 (m2/bagian/local size)

11.What are you main vegetable crops:

Dry season (2014)	Area (m2/*bagian/local size)*	Wet season (2013/2014)	Area (m2/*bagian/local size)*
1.	.....	1.	.....
2.	.....	2.	.....
3.	.....	3.	.....

12. Do you own or do you rent your land in use for vegetable production?

- o Rented
- o Owned
- o Both rented and owned

Production

13a. Vegetable production dry season (2014)

Refer to your most important vegetable crop. Please give estimations.

Crop	Estimated production (kg)	Costs for the applied pesticide? (IDR)	Costs for the applied fertilisers? (IDR)	Cost for the seeds? (IDR)
1)	.....	.....	.....	.....

13b. How much did you earn with this harvest (IDR)? .....

13c. What type of seed did you use?

- o Farm saved seed
- o hybrid seed
- o Other
- o I don't know

13d. How do you produce seedlings for your most important vegetables?

- o In trays plastic bag

- o I purchase seedlings
- o other
- o I don't know

14a. Vegetable production wet season (2013 / 2014)

Refer to your most important vegetable crop. Please give estimations.

Crop	Estimated production (kg)	Costs for the applied pesticide? (IDR)	Costs for the applied fertilisers? (IDR)	Cost for the seeds? (IDR)
1)	.....	.....	.....	.....

14b. How much did you earn with this harvest (IDR)? .....

14c. What type of seed did you use?

- o Farm saved seed
- o hybrid seed
- o Other
- o I don't know

14d. How do you produce seedlings for your most important vegetables?

- o In trays plastic bag
- o I purchase seedlings
- o other
- o I don't know

Fertilisers

Question 15a		*Question 15b*	
Foliar fertilisers are needed for good growth.	o Yes o Sometimes o No o Don't know	Do you use foliar fertilisers?	o Yes o Sometimes o No o Don't know

Crop protection

Questions 16a	*Question 16b*

Spraying 4 pesticides in a mix is more effective than spraying only 1.	o Yes o Sometimes o No o Don't know	I mix more than 4 pesticides for effective spraying.	o Always o Sometimes o Never o Don't know
Questions 17a		*Question 17b*	
The quality of the nozzle does not influence effective pest and disease control	o Yes o Sometimes o No o Don't know	How many times per year do you replace your nozzle?	o 4 times o 2 times o 1 time o Never o Don't know
Question 18a		*Question 18b*	
Pesticide spraying before it starts raining is preferred:	o Yes o Sometimes o No o Don't know	After spraying I let the workers work on the field	o Always o Never o Don't know

Health

Question 19

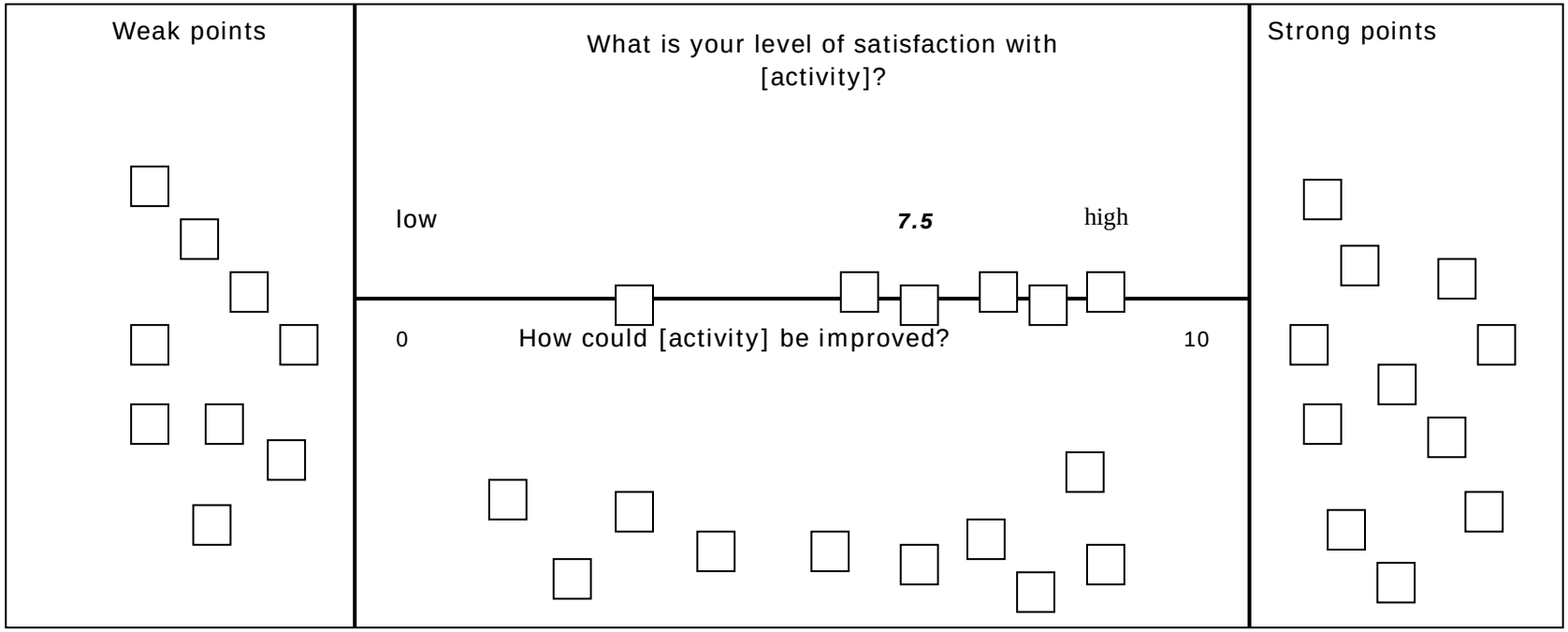
Mark the protective equipment that you or your farm workers use while spraying pesticides?	o Overall or long sleeves o Hat o Mask o Gumboots	o Goggles o Gloves o Other…. o None

Question 20a		Questions 20b	
Have you ever felt pain due to use of pesticides?	o Yes o Sometimes o No o Don't know	Number of sick days due to pesticide use in the last 2 cropping season?	o ..... Day/s

END

Appendix 3 H-Diagram

H-diagram:



Appendix 4 Tables Chapter 6 and 7

Tables Chapter 6: Intermediate outcome

Use of foliar fertilisers (in farmer %)	2014	2016
No	4.7	18.9
Yes	74.8	73.6
Sometimes	19.5	5.7
I do not know	1.0	1.7
Total	100	100

Table A4A The use of foliar fertiliser by farmers (n=575)

I mix more than 4 pesticides (in farmer %)	2014	2016
Always	18.1	11.7
Sometimes	44.1	16.9
Never	31.7	69.7
I do not know	6.1	1.8
Total	100	100

Table A4B Mixing of pesticides (n=558)

How many times per year do you replace your nozzle (in farmer%)	2014	2016
4 times	11.3	14.1
2 times	27.7	33.3
1 time	15.9	22.4
Never	38.3	28.5
I don't know	6.8	1.9
Total	100	100

Table A4C Replacement of nozzles by farmers (n=415)

After spraying I let the workers work on the field (in farmer %)	2014	2016
Always	30.5	19.1
Never	63.0	78.9
I don't know	6.5	1.9
Total	100	100

Table A4D Labourers in the field after spraying (n=554)

Tables Chapter 7: Ultimate outcome

Productivity in kg/ha	Dry 2014	2016	Wet 2014	2016
Pepper	13,2	10,7	14,1	25,8
Tomato	24,0	25,6	43,1	26,5
Cucumber	20,1	40,9	21,4	22,7
n dry			n wet	
Pepper	125	38	65	48
Tomato	73	120	57	131
Cucumber	12	37	7	32

Table A4E Average productivity (kg/ha *1000) and observations (n) per season, per year and per crop (significant decrease tomato wet season)

Production costs IDR/ha	Dry 2014	2016	Wet 2014	2016
Pepper	18300	19500	19400	24200
Tomato	19500	19400	26000	17600
Cucumber	6287	9503	9166	10000
n dry			n wet	
Pepper	138	45	76	48
Tomato	81	127	64	131
Cucumber	16	38	8	32

Price IDR/kg	Dry 2014	2016	Wet 2014	2016

Table A4F Average production costs in IDR/ha (*1000) and observations (n) per season, per year and per crop (significant decrease tomato wet season)

Pepper	15513	18762	14133	14127
Tomato	6386	6812	4838	4896
Cucumber	6194	1862	3574	2719

n dry			n wet	
Pepper	130	38	78	46
Tomato	82	118	71	131
Cucumber	15	37	13	32

Table 7A4G Average price received in IDR/kg and observations (n) per season, per year and per crop (significant decrease cucumber dry season)

Earnings IDR/ha	Dry 2014	2016	Wet 2014	2016
Pepper	156000	193000	136000	340000
Tomato	84300	129000	219000	116000
Cucumber	39000	60300	21100	60400

n dry			n wet	
Pepper	113	44	53	48
Tomato	66	122	52	129
Cucumber	12	38	7	32

Table A4H Average earnings in IDR/ha (*1000) and observations (n) per season, per year and per crop (significant decrease tomato wet season)

Margin IDR/ha	Dry 2014	2016	Wet 2014	2016
Pepper	136000	174000	113000	316000
Tomato	72700	110000	189000	98200
Cucumber	30800	50800	10600	50400

n dry			n wet	
Pepper	113	44	53	48
Tomato	66	122	52	129
Cucumber	12	38	7	32

Table A4I Average margin in IDR/ha (*1000) and observations (n) per season, per year and per crop (no significant changes)

Hot pepper, dry season			
Variable / year	**2014**	**2016**	***Change***
Land size (ha)	0.24 (n=191)	0.28 (n=58)	0.04
Productivity (kg/ha)	13193 (n=125)	10727 (n=38)	-2466
Price (IDR/kg)	15513 (n=130)	18762 (n=38)	3249
Earnings (IDR/ha)	156000000 (n=113)	193000000 (n=44)	37000000
Prod. cost (IDR/ha)	18300000 (n=138)	19500000 (n=45)	1200000
Margin (IDR/ha)	136000000 (n=113)	174000000 (n=44)	38000000
Tomato, dry season			
Variable / year	**2014**	**2016**	***Change***
Land size in ha	0.17 (n=122)	0.28 (n=164)	**0.11*** **
Productivity (kg/ha)	24008 (n=73)	25584 (n=120)	1576
Price (IDR/kg)	6386 (n=82)	6812 (n=118)	426
Earnings (IDR/ha)	84300000 (n=66)	129000000 (n=122)	44700000
Prod. cost (IDR/ha)	19500000 (n=81)	19400000 (n=127)	-100000
Margin (IDR/ha)	72700000 (n=66)	110000000 (n=122)	37300000
Cucumber, dry season			
Variable / year	**2014**	**2016**	***Change***
Land size in ha	0.18 (n=49)	0.2 (n=65)	0.02
Productivity (kg/ha)	20053 (n=12)	40875 (n=37)	20822
Price (IDR/kg)	6195 (n=15)	1862 (n=37)	**-4333***
Earnings (IDR/ha)	39000000 (n=12)	60300000 (n=38)	21300000
Prod. cost (IDR/ha)	6287323 (n=16)	9503046 (n=38)	3215723
Margin (IDR/ha)	30800000 (n=12)	50800000 (n=38)	20000000

Hot pepper, wet season			
Variable / year	**2014**	**2016**	***Change***
Land size in ha	0.21 (n=141)	0.24 (n=56)	0.03
Productivity (kg/ha)	14117 (n=65)	25755 (n=48)	11638
Price (IDR/kg)	14133 (n=78)	14127 (n=46)	-6
Earnings (IDR/ha)	136000000 (n=53)	340000000 (n=48)	204000000
Prod. cost (IDR/ha)	19400000 (n=76)	24200000 (n=48)	4800000
Margin (IDR/ha)	113000000 (n=53)	316000000 (n=48)	203000000
Tomato wet season			
Variable / year	**2014**	**2016**	***Change***
Land size in ha	0.19 (n=102)	0.31 (n=153)	**0.12*** **
Productivity (kg/ha)	43144 (n=57)	26530 (n=131)	**-16614*** **
Price (IDR/kg)	4838 (n=71)	4896 (n=131)	58
Earnings (IDR/ha)	219000000 (n=52)	116000000 (n=129)	**-103000000** **
Prod. cost (IDR/ha)	26000000 (n=64)	17600000 (n=131)	**-8400000** **
Margin (IDR/ha)	189000000 (n=52)	98200000 (n=129)	-90800000
Cucumber, wet season			
Variable / year	**2014**	**2016**	***Change***
Land size in ha	0.18 (n=49)	0.2 (n=65)	0.02
Productivity (kg/ha)	21391 (n=7)	22694 (n=32)	1303
Price (IDR/kg)	3574 (n=13)	2719 (n=32)	-855
Earnings (IDR/ha)	21100000 (n=7)	60400000 (n=32)	39300000
Prod. cost (IDR/ha)	9166042 (n=8)	10000000 (n=32)	833958
Margin (IDR/ha)	10600000 (n=7)	50400000 (n=32)	39800000

Table A4J Overview survey results per season on ultimate outcome level (*** (α = 0.01), ** (α = 0.05) and * (α = 0.1)

Appendix 5 Descriptive tables on same farmers baseline – endline

Tables:

A5A. Hot pepper: productivity, price, earnings, production costs and margin wet & dry season

A5B. Tomato: productivity, price, earnings, production costs and margin wet & dry season

A5C. Cucumber: productivity, price, earnings, production costs and margin wet & dry season

A5D. Overview in – and + per variable, year and crop

A5A. Hot pepper, dry season

Variable / year	2014	2016	*Change*	*n*
Productivity (kg/ha)	10084	8898	-1186	13
Price *	11460	21821	10360	9
Earnings	84500000	186000000	101500000	13
Prod. cost (IDR/kg)	16200000	17400000	1200000	21
Margin	63700000	168000000	104300000	9

Hot pepper, wet season

Variable / year	2014	2016	*Change*	*n*
Productivity (kg/ha)	8701	10151	-6685	13
Price	9905	14286	247	7
Earnings *	50900000	123000000	-50885714	7
Prod. cost (IDR/kg) *	9249405	24500000	113750595	16
Margin	42000000	107000000	-17500000	7

A5B. Tomato, dry season

Variable / year	2014	2016	*Change*	*n*
Productivity (kg/ha)	23180	24249	1068	36
Price *	5748	7733	1985	34
Earnings	103000000	156000000	53000000	37
Prod. cost (IDR/kg)	20700000	19900000	-800000	42
Margin	80200000	135000000	54800000	34

Tomato wet season

Variable / year	2014	2016	*Change*	*n*
Productivity (kg/ha)	23880	28014	4134	35
Price	5242	5970	727	32
Earnings	93600000	237000000	143400000	34
Prod. cost (IDR/kg)	23700000	19000000	-4700000	40
Margin	67100000	216000000	148900000	32

A5C. Cucumber, dry season				
Variable / year	**2014**	**2016**	***Change***	***n***
Productivity (kg/ha)	16917	33690	16773	4
Price	24083	12334	-11749	3
Earnings	38200000	93200000	55000000	4
Prod. cost (IDR/kg)	5020497	8904625	3884128	7
Margin	30200000	80500000	50300000	4

Cucumber, wet season				
Variable / year	**2014**	**2016**	***Change***	***n***
Productivity (kg/ha)	33000	21500	-11500	2
Price *	800	1500	700	2
Earnings	23000000	32300000	9300000	2
Prod. cost (IDR/kg)	9480000	14200000	4720000	2
Margin	13500000	18000000	4500000	2

A5D. Overview changes year and per crop

	Dry season					
Same farmers	Area	Prod.	Price	Earnings	Prod. Costs	Margin
H. pepper	**-**	-	+	+	+	+
Tomato	+	+	+	+	-	+
Cucumber	+	+	-	+	+	+

	Wet season					
	Area	Prod.	Price	Earnings	Prod. Costs	Margin
H. pepper	+	-	+	-	+	-
Tomato	+	+	+	+	-	+
Cucumber	+	-	+	+	+	+

Table A5D. Summary survey results per season on ultimate outcome level (+ = increase, - = decrease)

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The mission of Wageningen University and Research is ‘To explore the potential of nature to improve the quality of life’. Under the banner Wageningen University & Research, Wageningen University and the specialised research institutes of the Wageningen Research Foundation have joined forces in contributing to finding solutions to important questions in the domain of healthy food and living environment. With its roughly 30 branches, 5,000 employees and 10,000 students, Wageningen University & Research is one of the leading organisations in its domain. The unique Wageningen approach lies in its integrated approach to issues and the collaboration between different disciplines.