# Farming Practices of Vegetables: A Comparative Study in Four Regions of East Java and Bali Provinces

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**Abstract.** Agronomic and ecological aspects play important roles in vegetable production, because the aspects will be used for determining suitable interventions. This study aims to provide current farmers’ practices of vegetable production, particularly for agronomic and ecological aspects of chili and tomato in four regions of East Java and Bali. This study uses of analytical tool of descriptive approach by comparing and contrasting each production practices across regions. Data were compiled from a field survey of 360 farmers during 2013-2014. Results of analysis were presented in graphical and tabular forms. Farmers mostly selected hybrid varieties of vegetables because of economic reasons, such as high yield, good appearance and high number of fruits. Anthracnose and late blight were perceived as the most important disease in chili and tomato respectively. Farmers controlled pests and diseases using pesticides. In general, farmers perceived that irrigation was one of limiting factors of vegetable farming. Poor drainage was one of the crucial issues in Bali. Farmers mostly sold vegetable once harvested. Post-harvest handling was still traditional, where farmers still less pay attention on post-harvest, even though they observed the economic advantage of post-harvest. Based on the existing practices, a special extension on vegetable production needs to be formulated appropriately.

#### Keywords: vegetable farming, agronomic and ecological aspects, farmer’s perception

**Praktik Usahatani Sayuran: Studi Komparasi di Empat Daerah   
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**Abstrak.** Aspek agronomi dan ekologi memainkan peran penting dalam produksi sayuran, karena aspek tersebut akan digunakan untuk menentukan intervensi yang sesuai. Penelitian ini bertujuan untuk memberikan praktik petani produksi sayuran, terutama untuk aspek agronomis dan ekologis tanaman cabai dan tomat di empat wilayah di Jawa Timur dan Bali. Penelitian ini menggunakan analisis dengan pendekatan deskriptif yaitu membandingkan setiap praktik produksi sayuran pada masing-masing wilayah. Data dikumpulkan dari survei lapangan terhadap 360 petani selama 2013-2014. Hasil analisis disajikan dalam bentuk grafik dan tabel. Hasil kajian menunjukkan bahwa kebanyakan petani memilih varietas hibrida sayuran karena alasan ekonomi, seperti hasil panen tinggi, penampilan bagus dan jumlah buah yang tinggi. Anthracnose dan penyakit busuk daun dianggap sebagai penyakit terpenting pada cabai dan tomat. Petani mengendalikan hama dan penyakit dengan menggunakan pestisida. Secara umum, petani menganggap bahwa irigasi merupakan salah satu faktor pembatas budidaya sayuran. Drainase yang buruk adalah salah satu isu penting di Bali. Petani kebanyakan menjual sayuran setelah dipanen. Penanganan pascapanen masih tradisional, dimana petani masih kurang memperhatikan pasca panen, meski mereka mengamati keuntungan ekonomi pasca panen. Berdasarkan praktik-praktik yang ada, penyuluhan khusus pada produksi sayuran perlu dirumuskan dengan tepat.

**Kata kunci**: usahatani sayuran, aspek agronomi dan ekonomi, persepsi petani

## Introduction

Along with population growth, Indonesia is coping with food and nutrition security in terms of household hunger and malnutrition. The production of vegetable crops in Indonesia has grown both for domestic consumption and in exports to some extents. Diversification into vegetables could benefit many rural people by increasing both production and employment (Weinberger & Lumpkin, 2007). Diversification into vegetables could thus play a significant role in supporting food and nutrition security in Indonesia (Mariyono, Dibiyantoro, & Bhattarai, 2010).

Vegetables are high value cash crops; their production could well be targeted for inter-island and export marketing. As a major source of nutrients in the diet, providing a broad spectrum of essential micronutrients including pro-vitamin A, iron, and zinc, vegetables can contribute to the prevention of malnutrition disorders (Latifah, Andri, & Mariyono, 2014). While global types of vegetables (such as tomato and onion) are often more popular, there is a need to increase the utilization of indigenous vegetables’ great potential for daily sustenance, to diversify production systems and diets with indigenous vegetables, and to expand their use as cash crops. There is a potential to explore the vegetable production in a local economy (Widodo, 2015; Istiyanti, Khasanah, & Anjarwati, 2015).

Indonesian vegetable production grew by an average of 8% per annum, from 6.9 million tons in 2001 to more than 9 million tons in 2005, to cover almost one million hectares with an average yield of 9.6 tons per hectare. Chili production accounts for 20% of the land currently used for vegetable production, but produces only 12% of the total vegetable output due to low average yields. In comparison, cabbage and potato use only 6.3% and 6.8% respectively of vegetable land and have much higher yields, resulting in large production volumes. The main vegetables grown in Indonesia (besides mushrooms) and their average yields are cabbages (22.4 t/ha), chili (4.7 to 6.4 t/ha), potato (16.4 t/ha), shallot and onions (8.8 t/ha), and tomato (12.6 t/ha) (White, Morey, Natawidjaja, & Morgan, 2007).

The production of vegetables increased during the last decade (Figure 1). Chili had the highest growth rate. Production of chili increased from 1.2 million tons in 2003 to almost 1.9 million tons in 2013. This is due primarily to substantial improvements in irrigation infrastructure and the use of better cultivars over the period. Other vegetables also increased steadily because of the same factors noted for chili. Among the vegetables grown in Indonesia, chili is the highest in terms of acreage and volume of production.

Source: (BPS, 2014)

Figure 1. The dynamic trend of vegetable production in Indonesia, 2003-2013

Improvements in agronomic practices of vegetable production help farmers increase production. For example, seed technology can lead to use of other technology (Bhattarai & Mariyono, 2016). This is because vegetable production depends on conditions of agroecosystem. Agroecosystem conducive for vegetables leads potential production. Many factors affecting vegetable production, starting from seed selection, land preparation, crop maintenance, crop protection, harvest and post-harvest handling (Istiyanti et al., 2015). Before interventions for improving agronomic practices in vegetable production, we need to understand the current practices of vegetable production. As agroecosystem in Indonesia varies across regions, it is important to see the regional variation of agroecosystem that makes farmers to cope with local problem wisely. Specific local problem needs different approach, and this is useful for appropriate project intervention. This study aims to provide current farmers’ practices of vegetable production, particularly for chili and tomato, in main four vegetable-producing areas in East Java and Bali provinces. The results are expected to be used by policymakers in formulating appropriate intervention programs.

## Methodology

This study used a survey and adopted a framework of integration of qualitative and quantitative survey to meet the above objectives. The qualitative survey approach used for collection of social and institutional issues involved in chilli farming and the information at the community or group level average in the village. Quantitative one used the individual interview. This was conducted by interviewing selected farmers. Interviews were conducted by enumerators using structured questionnaires. Each selected farmer was questioned individually to avoid farmers from being influenced by one another. Every response from farmers was recorded in a questionnaire. Each questionnaire only recorded one farmer.

This survey illustrated agronomic production issues involved in vegetable cultivation in East Java and Bali provinces of Indonesia. The assessment was based on farmers' survey carried out during the research period of 2013-2014 in four communities: Kediri and Blitar of East Java; and Bangli and Tabanan of Bali. Data for this study were compiled from a quantitative survey of 360 farm households located in four major vegetable producing regions. Each of the communities/districts selected was the centre of vegetable production, particularly chilli, tomato, eggplant, shallot and cabbage/lettuce. Each site represents a distinct variation of production characteristic and agro-ecology settings of vegetable farming practice in the region.

Three major forms of descriptive data were analysed: sample mean, frequency and proportion, and weighted rank order. Analyses on frequency were conducted by counting the number of farmers who responded to a specific category of issue/response in the questionnaire. Once the frequency was obtained, the percentage of those from the sub-total of each district and total samples in the project area were calculated. If the frequency of a certain variable is higher than the others, then this particular variable is considered more important. Mean (average) value of a particular variable was estimated by calculating the sample average of the variable.

The report uses descriptive analysis. Mean comparison of quantitative data among regions was tested using simple t-test. For non-quantitative data, the analysis focused on the frequency of farmers' response. Qualitative data are represented by proportion (percentage) of farmers providing response relative to total farmers in each region and overall. The common formula of proportion is expressed as:

where *n* is the number of farmer providing response, *N* is total number of sampled farmers. Further analysis of the importance of information was conducing using a weighted average. Graphs were used to visually help in comparing important selected information.

Mean value was calculated using the formula:



where *Xi* is the variable of ith to be analysed, *N* is the number of sampled farmers. To provide information on the significance, a statistical *t*-test was provided as reported by the SPSS software package, which is formulated as:

n\*

where subscript k and j refer to the different districts, and *SDjk* is the standard deviation obtained from *xj* and *xk* . In this case, if the value of *t*-test is greater than the value t-table at 90% confidence interval, then the mean of the particular variables is significantly different from other survey sites.

For certain important factors, analyses on weighted rank were conducted by calculating the score reported by farmers. The weighted average rank is formulated as

where *n* is the number of farmers responding to each category, *S* is the score, and *N* is the total sample. A higher score was given for a particular response (variable) when farmers reported that such a variable was more important. For example, during the field survey, if there are five choices, and a farmer gave the first rank for a certain variable in a list, then the particular variable is scored (ranked) as 1. If the farmer put it in the second rank, then it is scored 2, and so on. If the farmer did not mention anything, then the score for this particular factor is zero. Thus, a higher value of weighted average rank means the factor (response) is more important and mentioned by many farmers during the survey. The statistical analysis was done with the SPSS software package and MSExcel.

## Results and Discussion

## Variety selection

Farmers cultivated small, curly and big chilies, and vegetable and fruit tomatoes. Almost all varieties of chili and tomato were identified hybrids. Farmers got the varieties from agricultural input stores around their villages. Small chili was mostly grown in Kediri, and the popular variety was Bhaskara; curly chili was mostly grown in Blitar, and the popular variety was TM999. While big chili was also grown in Blitar, and the popular variety was Gada-MK. In Bali, farmers cultivate hot chili, and the most popular variety was Wibawa. For tomato, Tymoti was the popular variety in East Java. While in Bali, Martha and Menara were hybrid variety of tomato that were mostly grown by farmers.

Farmers selected such variety because of various reasons. Almost all farmers in all regions stated that economic reasons, such as high yield, good appearance and high number of fruits behind the variety selection. It is common that economic motives are behind the choice of varieties (Mariyono, 2017b). Resistance to pests and diseases was also a strong motive of farmers to select varieties (Mariyono et al., 2010). Seed becomes one of important factors affecting productivity of vegetables (Sita & Hadi, 2016).

## Pests and Diseases

Pests and diseases are major limiting factors (Paramanandham, Rajkumari, Pattnaik, & Busi, 2017). Farmers need to cope with pests and diseases to get the potential of production (Mariyono, 2017a). Table 1 shows the most important pests and diseases in tomato and chili[[1]](#footnote-1). Anthracnose was perceived as the most important disease in chili, which potentially cause yield loss of up to around 27%. In Bali, potential yield loss caused by the disease was higher than that in East Java.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Table 1: Top three of pests and diseases in chili and tomato | | | | | | |
| Crop | Pests and diseases | Percentage of loss (%) | | | | |
| Tabanan | Bangli | Blitar | Kediri | Total |
|  | Anthracnose | 51a | 38a,b | 25b | 20b,c | 27 |
| Chili | Fruit fly | 30a,b | 71a | 25b | 22b,c | 32 |
|  | Aphids | 101 | 18a | 13a | 23a | 18 |
|  | Late blight | 7.94a | 5.00a,b | 0.22b | 2.80a,b | 3.97 |
| Tomato | Phytophthora | 8.97a | 0.23b | 0.02b | 3.21a,b | 3.39 |
|  | Fruit borer | 4.21a | 0.68a | 0.00a | 1.97a | 1.82 |
| **Note:** Values in the same row and sub-table not sharing the same subscript are significantly different at p< .05 in the two-sided test of equality for column means. Cells with no subscript are not included in the test. Tests assume equal variances. | | | | | | |

For tomato, late blight and *Phytophthora* were perceived the most important, despite low potential of yield loss. The rate of yield loss of tomato caused by pests and diseases were perceived low. This is an indication that farmers were able to control. But, if such pests and diseases were not controlled, the rate of yield loss could be very high, even could reach up to 100%, during bad weather.

In all areas, farmers made efforts to reduce the yield loss by controlling the pests and diseases. Farmers did not carry out a single method, but they apply combination of control measures to reduce the attacks of pests and diseases. Farmers always applied pesticides with frequency of spray 2-3 per week, during 5-8 weeks. Chili was applied more than tomato because chili takes longer than tomato to harvest. Pesticides were the main control measure, and sometimes pesticides were combined with other controls measures such as mechanical and cultural methods. Many factors affecting the use of pesticides (Mariyono, Kuntariningsih, & Kompas, 2018).

Table 2: The results of control measure of pests and diseases

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Crop | Results | % farmers’ statement | | | |
| Tabanan | Bangli | Blitar | Kediri |
|  | Effective | 12.36 | 10.11 | 28.09 | 49.44 |
| Chili | Partly effective | 6.45 | 17.20 | 38.71 | 37.63 |
|  | Not effective | 2.56 | 25.64 | 38.46 | 33.33 |
|  | Effective | 65.22 | 2.17 | 4.35 | 28.26 |
| Tomato | Partly effective | 19.23 | 15.38 | 7.69 | 57.69 |
|  | Not effective | 50.00 | 50.00 | 0.00 | 0.00 |

Table 2 shows that the effectiveness of control measures that were taken by farmers. Mostly farmers perceived that the control measures were effective or partly effective. The case of not effective occurred during outbreak and very bad weather and farmers were late to apply pesticides, particularly fungicides.

## Irrigation related issues

Irrigation is also essential in vegetable farming (Mukherjee, Sarkar, & Sarkar, 2018). During dry season, the availability of water for irrigation determines the performance of vegetable farming. Table 3 shows the irrigation condition in the project areas. Overall, the common source of water came from rain-fed and the common method of irrigation flooding with bed. Particular in Bangli, the main source of water was lake; and in Blitar, the main source of water was water canal or rivers. In Tabanan, the main source of water was rain-fed. The difference in source of water determines cropping pattern in each area. Farming relying on rain-fed as sole source of irrigation will be operated during rainy season.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Table 3: Condition of irrigation | | | | | | |
| Type and source of Irrigation | | Proportion (%) | | | | |
| Tabanan | Bangli | Blitar | Kediri | Overall |
| Source of water | Water canal | 0 | 0 | 68.3 | 38.7 | 22.3 |
| Well | 4.8 | 0 | 15.0 | 19.4 | 9.3 |
| Water tank | 0 | 0 | 6.7 | 4.8 | 2.4 |
| Lake | 8.0 | 90.9 | 0 | 0 | 17.2 |
| Rain fed | 86.4 | 9.1 | 0 | 37.1 | 46.4 |
| drinking water | 0.8 | 0 | 5.0 | 0 | 1.4 |
| Irrigation method | Flooding | 6.4 | 0 | 3.4 | 0 | 3.4 |
| Flooding with bed | 12.8 | 0 | 69.5 | 51.6 | 45.9 |
| Manual from well | 18.4 | 0 | 6.8 | 0 | 9.3 |
| Manual from tank | 51.2 | 0 | 15.3 | 32.3 | 32.1 |
| Pumped | 11.2 | 100 | 5.1 | 12.9 | 8.6 |
| Drip irrigation | 0 | 0 | 0 | 1.6 | 0.3 |
| Other | 0 | 0 | 0 | 1.6 | 0.3 |

Figure 1 shows the proportion of farmers facing irrigation problem. Overall, 70% farmers perceived that irrigation was one of limiting factors of vegetable farming. In Bangli, more 90% farmers stated that irrigation is serious problem. During rainy season, there was too much water such that the land flooded by the rising water lake. During dry season, water was available from the lake, but the cost of watering was high because irrigation needed to be carried out every day. This is because the soil type of land was sandy.

Figure 1: Problem of water irrigation

Of those perceiving that irrigation was the problem in vegetable farming, categorized into several issues, which are shown in Figure 2. In general, scarce water during dry season was perceived by farmers as the most important issue. Another important issue is that fact that vegetable farming was mostly situated in the sloped land, such that it was quite difficult to get adequate water. Within area of Bangli, even though 95% farmers stated that irrigation was one of limiting factors, they perceived that such problem has been overcome using water pump. They only stated that the issue of irrigation became important when fuel was scarce leading to high price of fuel.

Figure 2: The importance of issues related to irrigation

Table 4 shows the seriousness of water scarcity. Among farmers providing response, the water scarcity was not too serious. If those who did not providing response perceived that scarcity of water was not the problem, only about 10% of farmers stated that such problem was serious. Not that, in Bangli, water is always available from the lake, so they did not provide response related to water scarcity.

Table 4: Seriousness of scare water irrigation

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Response | | Proportion of farmers (%) | | | | | | | | | |
| Tabanan | | Bangli | | Blitar | | Kediri | | Overall | |
| No response | 40.3 | | 81.8 | | 68.3 | | 52.5 | | 55.0 | |
| Very lack | 5.6 | | 2.3 | | 10.0 | | 8.2 | | 6.6 | |
| Slightly lack | 18.5 | | 0 | | 5.0 | | 8.2 | | 10.7 | |
| Fair | 22.6 | | 13.6 | | 8.3 | | 23.0 | | 18.3 | |
| Serious | 2.4 | | 0 | | 1.7 | | 6.6 | | 2.8 | |
| Very serious | 10.5 | | 2.3 | | 6.7 | | 1.6 | | 6.6 | |

Despite such problem, farmers were able to cope with such that the problem did not stop farmers from operating vegetable farming. Farmers made efforts to cope with the problem by purchasing water from local government and use it as efficient as possible. During high water scarcity, farmers gave water to crops using watering can together with fertilizer application.

## Soil-related issues

Soil condition determines the performance because it is essential ecological capital (Manea, 2017). Agricultural and will be useless if the condition is unable to support crops (Morillas, Roales, Portillo-Estrada, & Gallardo, 2017). Figure 3 describes the main issues related to soil condition in surveyed areas. Overall, poor drainage was the main issues for vegetable farming. This is understandable because several high valued vegetables such as tomato and chili are sensitive to water lodging. In Bali, the issue was more important than in East Java, where poor drainage was as important as low soil fertility and low soil nutrient. More than 80% of farmers in Bali perceived that poor drainage was the important issue; contrast to that in East Java, which only accounted for about one-third.

Figure 3: Percentage of farmers perceiving main problem of soil condition

Figure 4 shows more detail of drainage condition in surveyed areas. Overall, drainage condition was not too bad. About 30% of farmers perceived that drainage condition was just good and fair. In Bali however, more than 80% farmers perceived that drainage in their land was poor.

Figure 4: Percentage of farmers perceiving drainage problem

Figure 5 describes soil fertility of agricultural land in the surveyed areas. Overall, the soil fertility was not too bad, except in Tabanan. One bad situation is the fact that about 50% of farmers in Bangli had no idea about soil fertility of their own land. Compare to those in other areas, this situation is worrying. Without knowing their soil fertility, they would just do “trial and error” in their farming.

Figure 5: Percentage of farmers perceiving soil fertility of land

Figure 6: Percentage farmers with different soil types

Drainage issue could be associated with the soil types (Wang et al., 2018). Figure 6 describes the composition of soil types. Overall, soil types in surveyed areas were sandy clay and sandy. In Bangli of Bali, where the drainage condition is the main issue was relevant to the soil type, which was sandy clay. In Blitar of East Java, the situation was quite similar to that in Bangli. In East Java, poor soil fertility and low soil nutrient were relevant to the sandy soil. Sandy soil was able to keep the soil humid; and soil nutrient is easily leached together with water.

Figure 7: Percentage of farmers knowing soil acidity (pH)

One factor that determines soil fertility is acidity of soil. This factor is important because it affect availability of soil nutrient to crops (Fangueiro et al., 2017). Extreme soil acidity enables essential nutrient will not be available to plants; and the condition also leads to crop intoxication. Unfortunately, more than 75% of farmers did not know the soil acidity of their land; even in Bangli more than 95% farmers did not know the soil acidity of their land (Figure 7). This is condition could be the root of soil problem in Bangli.

Figure 8: Percentage of farmers have conducted soil test

Lack of knowledge on soil acidity is explainable because about 90% farmers have not tested soil of their land in adequate soil laboratory (Figure 8). Thus, they did have any information related to physical, chemical and biological characteristics of soil. As the farmers lack of information on soil fertility, they have not been observing the signs and symptoms of nutrient deficiency related to soil fertility.

## Post-Harvest Handling

A potential risk is because vegetables are perishable products, which relate to post-harvest losses. After harvest, fresh vegetables are transported from the farm to either a packing house or distribution center. For some crops such as fruits, vegetables, and root crops, being less hardy than cereals, post-harvest losses can reach 50% (Anonymous, 2008). Reduction in these losses would increase the amount of food available for human consumption and enhance global food security (Anonymous, 2008; Trostle, 2010).

Post-harvest handling is the last action of farming before marketing. This step is important because it determines the price of vegetable produces. Many factors affect the quality of vegetable produces. One of them is variety of crops since each variety has special characteristics. Table 5 shows that more than 50% farmers giving response perceived that variety of chili influenced the quality. There is indication that the variety chili in East Java was more important than that in Bali. This is understandable since chili in East Java was marketed at national level. Whereas, chili in Bali was marketed to only fulfill local market in Bali.

Table 5: Effect of variety on product quality

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Crops | | Proportion of farmers | | | | |
| Tabanan | Bangli | Blitar | Kediri | Overall |
| Chili | No response | 79.4% | 65.9% | 26.7% | 12.9% | 45.0% |
| Affect | 12.7% | 25.0% | 40.0% | 48.4% | 31.9% |
| Not affect | 7.9% | 9.1% | 33.3% | 38.7% | 23.1% |
| Tomato | No response | 63.5% | 75.0% | 95.0% | 77.4% | 77.7% |
| Affect | 20.6% | 15.9% | 1.7% | 8.1% | 11.4% |
| Not affect | 15.9% | 9.1% | 3.3% | 14.5% | 10.9% |

The case of chili is different from that of tomato. Variety of tomato was perceived to not to have huge influence on the quality. Market preference on tomato did not affect much by the variety. In the case of Tabanan, where farmers have special market for tomato, the verity of tomato is more important than other regions.

Since each variety has different special characteristics, many factors characterized the variety affect the quality of vegetable produces. Table 6 shows that size, color and shape of chili were the important factors affecting quality of chili. In East Java, farmers put more weight on these factors than those in Bali.

Table 6: Factors affecting quality of chili

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Factors | Rank order (the higher the better) | | | | |
| Tabanan | Bangli | Blitar | Kediri | Overall |
| Size | 1.41 | 3.18 | 4.57 | 5.84 | 3.78 |
| Color | 1.33 | 2.52 | 3.90 | 5.34 | 3.32 |
| Shape | 1.24 | 2.84 | 3.82 | 4.08 | 2.99 |
| Taste | 0.93 | 0.33 | 0.83 | 1.60 | 1.00 |
| Water content | 0.44 | 0.25 | 0.72 | 2.06 | 0.92 |
| Aroma | 0.51 | 0.27 | 1.27 | 1.39 | 0.90 |

In the case of tomato, size, color and shape were also important factors in affecting quality of tomato (Table 7). But the rank of such factors in tomato was lower than that in chili. In contrast to East Java, farmers in Bali posited greater weight for such factors than those in East Java. One of sensible reason is that Bali and East Java have different target of marketing.

Table 7: Factors affecting quality of tomato

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Factors | Rank order (the higher rank the better quality) | | | | |
| Tabanan | Bangli | Blitar | Kediri | Overall |
| Size | 2.71 | 2.27 | 0.50 | 1.53 | 1.73 |
| Color | 2.41 | 1.82 | 0.50 | 1.05 | 1.43 |
| Shape | 2.48 | 1.93 | 0.35 | 0.97 | 1.41 |
| Taste | 1.27 | 0.32 | 0.35 | 0.23 | 0.56 |
| Water content | 0.81 | 0.18 | 0.33 | 0.29 | 0.42 |
| Aroma | 0.73 | 0.20 | 0.20 | 0.15 | 0.33 |

There are potentials to improve and modernize the vegetable farming practices since many farmers still in traditional and subsistence stages. The role of extension services become important. Farming practices can be improved by sending the farmers in informal schools (Kuntariningsih & Mariyono, 2013a), and encouraging farmers with the use of modern technology (Kuntariningsih & Mariyono, 2014). As many factors effecting the use of modern technology (Kuntariningsih & Mariyono, 2013b), the extension services should be updated with the current condition (Wulandari, 2015).

**Conclusion and Policy Implication**

Agroecological aspects that play important roles in vegetable production include selection of hybrid varieties of vegetables, and crop protection practices. Anthracnose and late blight were perceived as the most important disease in chili and tomato respectively. Farmers perceived that irrigation was one of limiting factors of vegetable farming. Poor drainage was one of the crucial issues in Bali. Soil fertility was not the main issues, but there was a bad situation that farmers did not know about soil fertility of their land. Farmers mostly sold vegetable once harvested. Post-harvest handling was still traditional, where farmers did not pay attention to much on it. Thus, Post-harvest handling still need more attention by farmers since only small fraction of farmers were aware on that, even though they observed that high quality of produce provides price premium.

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1. Tomato and chili are the main vegetable crops grown by surveyed farmers. Other crops such as eggplant, shallot, cabbage only minors, and usually grown as intercrops along site of land border. [↑](#footnote-ref-1)