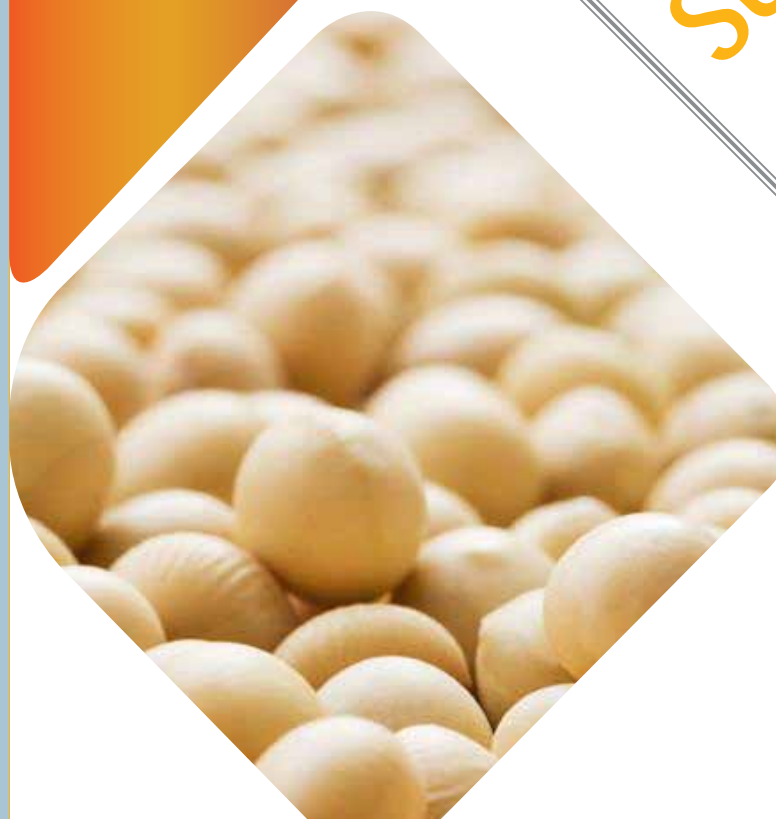




The Study of Soybean Supply Chain in Chiang Mai Thailand



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Chapter 1 Introduction

1.1 Background

Chiang Mai soybean's supply chain in Thailand has been chosen for a study since, at present, Thailand needs a great amount of soybean for consumption and industrial purposes. Moreover, there is a demand of soybean residue for producing animal feed's ingredients. 95% of soybean demand is imported from America continent while only 5% of soybean demand is produced in a country.

Important soybean sources of production are situated in the Northern and Northeastern regions. Chiang Mai is one of the provinces in the Northern region which is important for soybean production owing to the fact that it is a center for accumulating and distributing the products as well as being one of crucial sources of production of soybean seed variety in the country. It can be seen that there are various agricultural cooperatives in Chiang Mai that promote soybean planting and purchasing soybean products from farmers. Moreover, there is Chiang Mai's plant seeds research and development center where Chiang Mai 60, the most popular variety due to its unique taste and scent and widely accepted by consumers, is created

1.2 Objectives

- 1) To study general description of soybean in Chiang Mai
- 2) To analyze cost and return of soybean production in Chiang Mai
- 3) To study marketing channel and supply chain of soybean in Chiang Mai

1.3 Scope of the Study

- 1) Population: soybean farmers in Chiang Mai
- 2) Survey Area: soybean production area in Chiang Mai
- 3) Entrepreneurs in Chiang Mai and Sa Kaeo

1.4 Period of the Study

From November 2017 to May 2018

1.5 Definition of Terms

Soybean means soybean which farmers planted to harvest its seeds for consumption and foods industrial purposes e.g. vegetable oil, fermented soybeans, tofu and ingredient of animal feeds, but excluding soybean which farmers planted to harvest its raw pod and boil which is called "Pigeon Pea".



Soybean Wet Season (the beginning and the ending of the rainy season) means soybean which is planted from May 1st to October 31st of the same year regardless of when it is harvested.

Soybean Dry season means soybean which is planted from November 1st to April 30th of the following year regardless of when it is harvested.

Soybean Variety means soybean seeds which farmers used for planting. The popular varieties are SJ.4, SJ.5, CM.2, CM.60, NW.1, ST.1, ST.2, MKh.35 and Chakarbhand.

1.6 Methodology

1) Data Collection

(1) Primary Data: surveying and collecting data by interviewing soybean farmers in important sources of production in Chiang Mai namely Amphoe Phrao, Amphoe Mae Taeng, Amphoe Mae Rim, Amphoe San Pa Tong and Amphoe Hang Dong in total of 85 samplings. Using purposive method on merchants and entrepreneur namely agricultural cooperatives, merchants and major accumulators in total of 7 samplings.

(2) Secondary Data: by collecting academic papers and information from relevant agencies e.g. Department of Agricultural Extension, Department of Agriculture, Thai Customs Department and private agencies.

2) Data Analysis

(1) Descriptive Analysis by using data received from farmers' interview to describe soybean production process, problems and challenges of soybean production. Such data will be shown in percentage.

(2) Quantitative Analysis by analyzing cost and return of production. Both cash and non-cash cost will be considered.

1.7 Expected Benefits of the Study

1) For a government sector to adopt for policy making on guidelines and measures on soybean production and marketing.

2) Farmers are aware of their production cost and are able to reduce their own cost.

3) Entrepreneurs and processors are able to use (the study) to efficiently purchase soybean.

Chapter 2 General Information

2.1 General Information on Soybean

1) History of soybean

Soybean is considered an important plant and one of the ancient edible plants of the world. The Chinese have learnt to use this plant for over 4,700 years. There are various ways of soybean usage which are being human food which can be consumed directly or used as seasonings, using in industry and using as animal feeds since soybean seeds contain a lot of protein and oil. There is 35-40% of protein and 15-25% of oil in soybean seeds. Apart from its usage as foods, soybean is considered a good soil-nourishing plant. It is considered a good green manure when ploughing up and over the soil. After extracting oil from soybean seeds, its residue can also be used as fertilizer.

Nowadays, soybean is widely planted in both tropical and warm zone. Nevertheless, its yield tends to be better when planting in warm zone since its origin is in the warm zone. In Thailand, soybean has been planted for a long time. Planting occurred in the Northern region in the beginning and to other regions afterwards. However, its yield is inadequate particularly for soybean meal which is used as animal feeds. According to accessible information, soybean is originated in China, whether the central or the northern region since a wild variety of soybean called *Glycine Ussuriensis* was generally found in such regions. At least, the Chinese have used soybean as foods for over 4,700 years according to Emperor Shen Nung's journal. In approximately 2,000 years ago, soybean was brought from China to Korea for planting and maybe planted in Japan around 6th – 8th century. In 1740 A.D., a group of missionary, who entered China for evangelism, sent soybean seeds to France for planting. In 1790 A.D., soybean was further planted in Kew Gardens, England and to the USA prior to 1804 A.D. since records regarding such plant were originally found in the said year.

2) Use of Soybean

Soybean is considered multi-purpose plant especially its use as foods since it is a seed plant enriched with protein and oil. Its usage can be categorized as follows:

(1) **Foods** when its seeds are well-grown but not overripe, it can be boiled for consumption called “pigeon pea”. Some varieties of soybean have large seeds which can be rawly eaten or canned. When the seeds are ripe, they can be grown to be beansprout which are similar to those of green beans. Besides, it can be used to make fermented bean, tofu, soy sauce, soymilk or artificial meat called meat analogue where it is manufactured to resemble chicken meat, beef, turkey, ham, bacon, etc. for vegetarians or those who do not consume meat or pork. Nowadays, meat analogue is consumed in certain parts of the

USA. In addition, soybean flour is mixed or cooked in numerous kinds of foods e.g. bakery, baby formula, etc. Oil extracted from soybean is used in food seasoning, margarine, salad dressing, etc.

(2) Industrial Use it is used to make glue, insecticide, color, fertilizer, vitamin, medicines, papers, clothes, electric insulators, printing ink, soap, cosmetics, beer, fibers, etc., where it is used as a mixture of the products or to enhance products' functions.

(3) Fertilizer or Soil Nourisher soybean and other beans are considered soil-nourishing plants. When ploughing soybean up and over soil before it is ripe, it will be great green manure to nourish soil and enhance soil condition. Soybean roots contain nodule inhabited *Rizobium Japonicum*. Such bacteria triggers nitrogen fixation that plants are able to use as their fertilizer in a form called nodule. After harvesting soybean, such roots and nodule will remain in the soil, nitrogen which was fixed will become fertilizer for other plants.

3) Botany of Soybean

Soybean is in a leguminosae family with various scientific names e.g. *Glycine Soja*, *Soja Hispida*, *Phaseolus Max*, etc. Nevertheless, the accepted name is *Glycine Max* (L.) Merrill

Root Soybean has a tap root system. In loosed soil, its tap root can grow from 0.5-1.00 m. deep. In shallow soil surface, its tap root will not be easily seen and there will be more lateral root. Generally, its root system will only be 30-45 cm. deep from the soil surface. Nodule will be found in the roots as a result of *Rhizobium Japonicum*'s inhabitance. Bacteria will receive carbohydrate from soybean and soybean will receive nitrogen in form of nitrate derived from fixation by bacteria. Bacteria coexistence in soybean's roots is called symbiosis or interdependence.

Stem Most of soybean planted for commercial purpose have straight stem and a lot of branching out. Its height is approximately 30-150 cm. depending on soil nourishment, humidity and planting season. Soybean can be divided into 2 following types based on how they grow:

(1) Indeterminate Type: Inflorescence of this type does not occur at the top of its main stem but its leaf corner, thus, its growth period can be extended. After flowering, this type of soybean will have long and slender end causing its growth to stop after podding.

(2) Determinate Type: Inflorescence of this type occurs at the top of its main stem. Most of this type of soybean have brown or grey hair covered themselves, for example, their stems, leafstalks, leaves, sepals, seeds, but excluding their cotyledon. Buds will be found between the corner of their cotyledon or leaves which will grow into branches, flowers or become dormant. If soybean is well grown, their buds tend to become branches. In narrow planting area, their buds will be dormant, while, in wide planting area, there will be 5-6 branches per a stem. Buds at the corner of the cotyledon will not grow unless a stem above such cotyledon is endangered e.g. bitten by insects. In this case, buds at the corner of the cotyledon will grow into a stem.

Leaf Their leaves will be alternate and growing on their stem except for their cotyledon and primary leaves which grow opposite to each other. Their primary leaves are simple leaves but leaves growing in the next stage will be compound leaves. Their leaves come in different shapes, often in Pinnately Trifoliate meaning there are 3 leaflets and 5-10 cm. long petiole. Petiolules of their middle leaves are longer than petiolules of the other 2 leaves. There are pulvinuses at the bottom of their leafstalk. Their leaves come in many forms e.g. ovate, lanceolate. There is brown or grey hair covered most of their leaves. There is a stipel at the bottom of their leaflets and a stipule at the bottom of their leafstalks. For most varieties, their leaves will start to fall when their seeds are ripe. When the seeds are completely ripe, all seeds will fall down. There are only few varieties which their leaves stay after their seeds are ripe.

Flower Soybean has inflorescence in form of raceme. Its flowers are white or purple. The white ones are recessive. When its flowers are fully blossomed, it will be 3-8 cm. long. Flowers grow in the corner of its leafstalk or at the top of its stem as mentioned. On one inflorescence, there will be 3-15 flowers. Inflorescence growing at the top of its stem tends to have more flowers than those grown in the corner of its leafstalk .

Flowers consists of the follwings:

1. Peduncle and pedicel
2. Bracteole is situated in the outer part, has green color, short, has 2 petals and covered with hair
3. Calyx is situated next to bracteole, has a connecting base and 5 calyx lobes.
4. Petal or Corolla, there are 5 petals which are 1 standard, 2 wing petals and 2 keel petals.
5. Stamen, there are 10 anthers (9 connecting to one another and 1 isolated which is called diadelphous)
6. Pistil, there are stigma and style on the upper part and there are ovary containing 1-4 ovules on the lower part.

Pod Pods grow in a group with 2-10 pods per group. There is grey or brown hair covered most of the pod. A pod is 2-7 cm. long and each pod contains 1-5 seeds but mostly 2-3 seeds per pod. When ripe, the pod becomes brown and may crack causing the seeds to fall down.

Seed Seeds come in different shapes and sizes. 100 small seeds approximately weighs 2 g. while 100 large seeds approximately weighs 40 g. and the average weight is 12-20 g. The seeds may be oval or long and may come in yellow, green, brown or black.

4) Growth Stage of Soybean

Growth Stage of Soybean can be divided into the following stages:

- Vegetative Stage represented by V
- Reproductive Stage represented by R

In indicating V, a number of its nodes on the main stem shall be considered by counting the nodes which their leaves have not yet spread out and divided by 2. If there are 6 nodes then it will be V3. While R starting with R4, which is when 50% of the stem has at least 1 blooming flower. Therefore;

- V0 there are simple leaves
- V1 there are 2 nodes (above the simple leaves) and the first pair of compound leaves has spread out.
- V2 there are 2 nodes and 4 sets of compound leaves
- V3 there are 6 nodes and 6 sets of compound leaves
- R4 the flowering stage with 50% of the stems has at least 1 blooming flower
- R5 full bloom stage reaches flowers on the second-top node starts and start podding
- R6 there is a pod on one of the 4 top nodes of the stem
- R7 Pods on the 4 top nodes are approximately 2 cm. long.
- R8 Seeds start to grow in one of pods on the 4 nodes
- R9 Pods specified in R7 and R8 have full grown seeds
- R10 Pods start to become yellow and 50% of the leaves are yellow which is considered a physically mature stage
- R11 95% of the pods become brown and able for harvesting

5) Suitable Weather and Soil Condition for Soybean Planting

Soybean is more suitable for planting in warm or subtropical zone rather than tropical zone since its origin is in the warm zone. Weather change and planting season significantly affects this plant that it is believed to have restricted adjusting ability. However, such plant can be planted in the tropical zone but it may not provide a great deal of yield because of photo-thermosensitivity. Soybean is a short day plant. If a day is shorter than 13 hours, it will flower. But, if a day is longer than mentioned, it will delay flowering or does not flower. In this case, stem, branches, and leaves will grow further. Thus, in tropical zone where a day is shorter, there will be time for stem, branches, and leaves to grow but it will start flowering faster. Nevertheless, its productivity is low. Besides, in lower temperature, soybean will start to flower slower than those in higher temperature. Owing to its complicated physiology, soybean variety should be directly developed for each planting area. Bringing seeds abroad or from other planting areas may not lead to success.

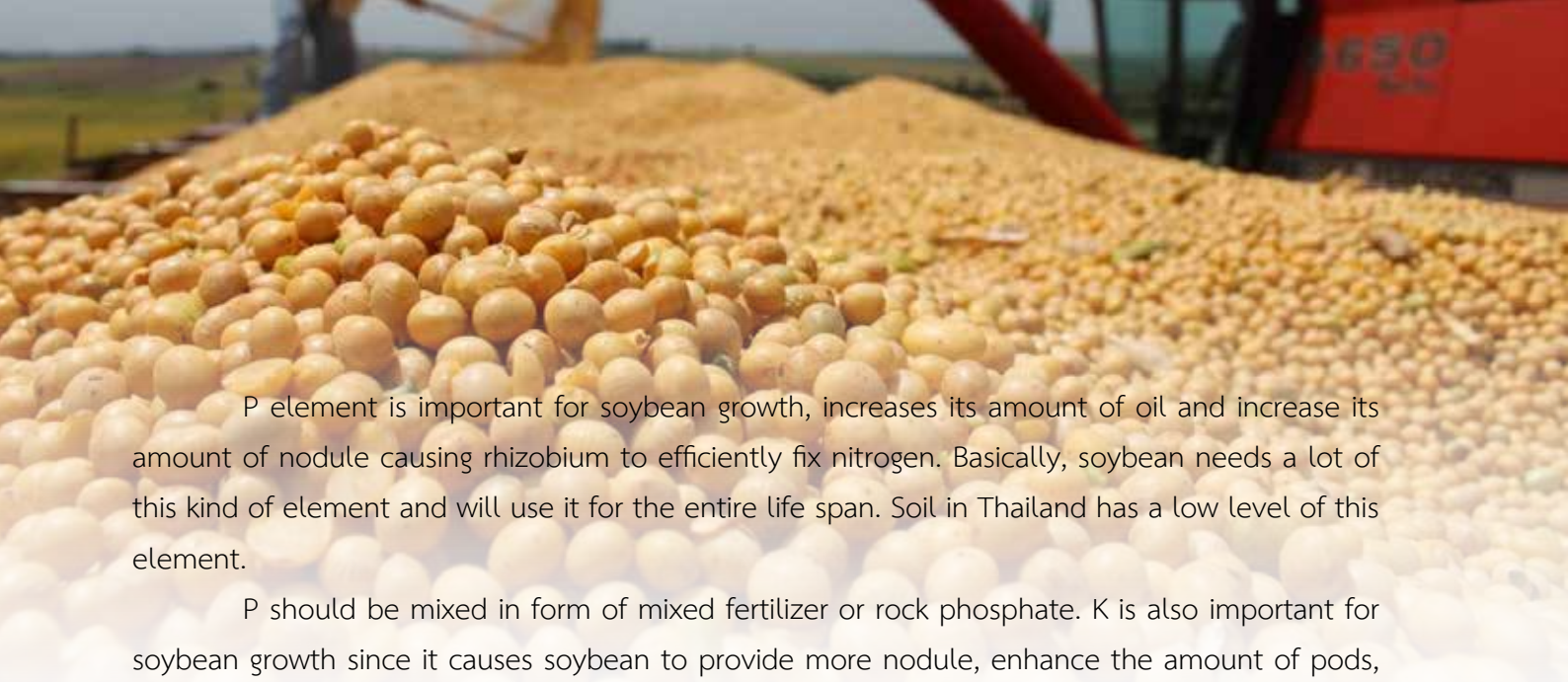


6) Planting Soybean in Thailand

(1) Soil Soybean grows in almost any kind of soil but it provides good productivity if planted in nourished soil. That is, loosed soil mixed with a small portion of sand, not water-absorbing and not too acidic or alkaline which means its pH is between 5-8 and 7.0, a range where rhizobium flourish causing soybean to have a lot of nodules and nitrogen fixation. Soil which is suitable for soybean planting should have 1-2% of organic matter. If lower than mentioned, such condition of soil is not suitable for soybean. If the percentage of organic matter being too high, soybean will grow by stems, braches and leaves which will provide less pods.

Soil in which soybean never grows or has not been planted for a long period of time, rhizobium should be mixed with soybean seeds since such bacteria does not exist in such soil or is inadequate or if there is, it might be of that different kind. According to an experiment conducted in many regions in Thailand, mixing rhizobium causes soybean to provide 20-50% more yield. At present, propagating bacteria may not be popular, those interested may buy from Department of Agriculture. Mixing process is described on a package of rhizobium. In an area where soybean is planted annually, mixing rhizobium is not needed since there will be rhizobium remaining long enough to enhance nodule in the following year.

(2) Applying fertilizer and calcium hydroxide Applying fertilizer is neccesary when soil is undernourished. Manure or chemical fertilizer or both may be applied. Applying only manure will never provide adequate important nutritions, hence, chemical fertilizer should also be applied. Important elements in chemical fertilizer are Nitrogen (N), Phosphorus (P) and Potassium (K). In the event that rhizobium is already mixed, slight amount of N is needed, that is 18.75-37.5 kg. per ha. In the event that rhizobium is not already mixed, then 37.5-150 kg. of nitrogen per ha should be mixed (depending on kinds and condition of the soil). This type of fertilizer should be applied twice. The first time is prior or after planting, the second time is before flowering. After mixing rhizobium, if nitrogen is excessively applied, there will be less nodule or the nodule will be small. If nitrogen is applied after the nodule starts its nitrogen fixation, it will not affect soybean's yield.



P element is important for soybean growth, increases its amount of oil and increase its amount of nodule causing rhizobium to efficiently fix nitrogen. Basically, soybean needs a lot of this kind of element and will use it for the entire life span. Soil in Thailand has a low level of this element.

P should be mixed in form of mixed fertilizer or rock phosphate. K is also important for soybean growth since it causes soybean to provide more nodule, enhance the amount of pods, seeds and increase the seeds' weight.

Fertilizer formular which the Department of Agriculture tends to use in an experiment is 3-9-6 N, P₂O₅, K₂O kg./ha. N is expected to increase if there is no rhizobium mixing. Other formulas are 15-15-15, 12-24-12, 16-20-0 in total of 156.25-187.5 kg./ha. If rock phosphate is applied, then 625-937.5 kg./ha. should be used.

Apart from such important elements, soybean still needs several kinds of secondary and micro-nutrients namely, calcium (Ca), magnesium (Mg), sulphur (S), iron (Fe), manganese (Mn), molybdenum (Mo) and zinc (Zn). These types of element is slightly needed. Indicating its inadequacy is hard but if there is, soybean's yield will decrease, for example, in an experiment conducted in Loei and Chiangrai, it is found that if molybdenum is applied, soybean's yield will increase by 30-50%.

Applying calcium hydroxide to adjust soil condition is very important for acidic or alkaline soil since nutrition attraction from soil by soybean significantly correlates with soil pH. If the soil's pH is 6.0-7.0, P, K and other kinds of elements will work well. If lower than mentioned, such elements will be fixed in soil. Moreover, the soil which has a pH of 6.0 - 7.0 is suitable for soybean nodule's development. Prior to planting soybean (or other plants), soil sample should be sent to the concerned government agencies for soil condition inspection. An inspector will provide firm recommendation on how to enhance and adjust soil condition before planting. At present, farmers should be aware of the nature and features of their own products.

(3) Planted Variety of Soybean Originally, the variety used is called local variety which is planted in every area for a long period of time or was selected in that area e.g. Mae Rim, San Pa Tong, etc. Later, Department of Agriculture has developed and selected new varieties which are SJ.1, SJ.2, SJ.4 and SJ.5. The varieties which are popular for planting nowadays are SJ4 and SJ5. as they are able to withstand rust disease. Besides such varieties, the new ones are, Nakhon Sawan 1, Sukhothai 1 and Chiang Mai 60.

Examples of Soybean Varieties and features of each variety

Popular varieties can be divided based on harvesting period into 3 groups and have agricultural features as follows

1. Short life-span variety 75-85 days planting dates, determinate stem, 30-50 cm. in height, wide leaves, stem, leaves and pods covered with brown hair, its flowers are purple, its pods are brown, its seed shell is yellow, its seed pole is brown. There are 2 varieties which are:

1.1 Nakhon Sawan 1 provides yield of 1,531.25 kg./ha, its weight per 100 seeds is 18-19 g., contains 21% of oil and 39% of protein, averagely resistant to bacterial pustule, non resistant to downy mildew and suitable for planting in the lower-northern and the upper-central regions.

1.2 Chiang Mai 2 provides yield of 1,468.75 kg./ha, its weight per 100 seeds is 15-16 g., contains 19% of oil and 35% of protein, averagely resistant to downy mildew and bacterial pustule and suitable for planting in every region.

2. Average life-span variety 86-112 days planting dates, mostly has determinate stem, 60-80 cm. in height, wide leaves, stem, leaves and pods covered with brown hair, its flowers are purple, its pods are brown or dark brown, its seed shell are yellow, its seed pole is light brown or black-brown. There are 9 varieties which are:

2.1 Chiang Mai 60 its flowers are white, provides yield of 1,875 kg./ha, its weight per 100 seeds is 15-17g., contains 20% of oil and 44% of protein, resistant to bacterial pustule, mosaic virus and rust disease and suitable for planting in every region.

2.2 SJ.5 its flowers are purple, provides yield of 1,718.75 kg./ha, its weight per 100 seeds is 13-15 g., contains 19% of oil and 42% of protein, resistant to rust disease and suitable for planting in the upper-northern and northeastern regions.

2.3 SJ.4 its flowers are purple, provides yield of 1,750 kg./ha, its weight per 100 seeds is 13-15 g., contains 18% of oil and 39% of protein, resistant to rust disease and suitable for planting in the upper-northern and northeastern regions.

2.4 Sukhothai 1 has indeterminate stems, narrow leaves, stem, leaves and pods covered with white hair, its pods are black-grey, provides yield of 1,531.25 kg./ha, its weight per 100 seeds is 14-16 g., contains 21% of oil and 39% of protein, resistant to bacterial pustule and red leaf virus and suitable for planting in the lower-northern and upper-central regions.

2.5 Sukhothai 2 has indeterminate stems, narrow leaves, its seed pole is black, provides yield of 2,000 kg./ha, its weight per 100 seeds is 14-16 g., contains 22% of oil and 38% of protein, resistant to bacterial pustule, soybean mosaic and downy mildew, and suitable for planting in the lower-northern and central regions.

2.6 Chiang Mai 3 has indeterminate stems, stems, leaves and pods covered with white hair, its pods are black-grey, its seed pole is brown-black, provides yield of 2,062.5 kg./ha, its weight per 100 seeds is 12-13 g., contains 22% of oil and 39% of protein, resistant to bacterial pustule, downy mildew, soybean mosaic and rust disease and suitable for planting in every region.

2.7 Sukhothai 3 its flowers are white, its seed pole and seed shell is black, provides yield of 1,875 kg./ha, its weight per 100 seeds is 12-14 g., contains 24% of oil and 43% of protein, averagely resistant to bacterial pustule, and suitable for planting in every region.

2.8 Chiang Mai 4 has indeterminate stems, stems, leaves and pods covered with white hair, its pod are black-grey, provides yield of 2,031.25 kg./ha, its weight per 100 seeds is 12-13 g., contains 21% of oil and 40% of protein, resistant to bacterial pustule and downy mildew and suitable for planting in eastern and upper-northeastern regions.

2.9 MKh.35 developed by Khon Kaen University, its flowers are white, its seed pole is black, provides yield of 1,906.25 kg./ha, its weight per 100 seeds is 16-17 g., contains 20% of oil and 47% of protein, resistant to bacterial pustule and downy mildew and suitable for planting in the central and upper-northeastern regions.

3. Long life-span variety 115-120 planting dates, there is only one variety which is:

3.1 Charkabhand 1 developed by Kasetsart University, has indeterminate stem, its height is 70 cm., wide leaves, stem, leaves and pods covered with brown hair, its flowers are purple, its pod is brown, it's seed shell is yellow, its seed pole is brown, provides yield of 1,781.25 kg./ha, its weight per 100 seeds is 11-12 g., contains 22% of oil and 41% of protein, averagely resistant to bacterial pustule and suitable for planting in the central and the northeastern regions.



(4) Planting Process Prior to planting, soil must be prepared in the same way of planting other plants, however; in planting soybean, soil must be loosed in order that the seed is able to absorb soil's humidity and grow. If practicable, calcium hydroxide should be sowed and plow for several days before planting. Before plowing for the last time, fertilizer should be sowed. The last plowing should be conducted 10-15 cm. deep. After that, planting row should be made with a 40-50 cm. space between each row. Planting can be executed by drilling into the bed with a 3-4 cm. space between each seed. If done so, there is no need for removing seedling since it will grow properly. If hill planting is done, there should be a 10-20 cm. space between each hill. There should be 4-5 seeds dropped in each hill. If there are too many seedlings, they should be removed so that there are 2-3 stems remaining in each hill. Leaving each hill having too many seedlings will cause small stems, less branches and pods due to the fact that they have to share nutrition and humidity.

Such planting process is recommended by Department of Agriculture's experiment and published by Department of Agricultural Extension. However, a small number of farmers adopt such process, most farmers chose sowing densely or drill planting by using 93.75-187.5 kg. of seeds per ha. Fertilizer and calcium hydroxide is not applied at all since it is cost-consuming. Moreover, sowing seeds densely will also prevent weed.

Planting in dry season in a rice field after rice planting season (like in Chiang Mai) is conducted by cutting stubble as short as the soil level, then letting water enter the rice field so that the soil is humid but not water-absorbing. After that, dropping 4-5 seeds into each stubble. The space between each cluster depends on the space between each stubble. Then, ashes should be applied to cover the stubble to prevent rats from eating the planted seeds. In addition, a spade may be used to bury seeds near the stubble. This process may also be redone by burning all stubble so that the weed, disease and insects are vanished. It should be noted that planting in a rice field after rice planting season does not involve ploughing or soil preparing and fertilizer is not applied. This is considered a by-product or soil-nourishing planting and the yield is lower than usual.

(5) Caring After planting, weed control chemical should be sprayed e.g. spraying alacor. Post-planting caring is the main contribution to soybean's yield. Caring begins since removing seedlings. If seedling is too densed, then, some should be removed. In case of hill planting, there should be 2-3 seedling remaining in each hill. In case of drill planting, each seedling should have a 5-8 cm. space between one another. Such space between seedling is proven to provide highest yield per ha. Removing is done when seedling is 10 days old. Broadcast sowing does not facilitate any work after planting but disease and insect preventing spraying.

In case replanting is needed, it should be conducted quickly because if delayed, it will also delay the yield. Weed prevention is very important. If practicable, on the planting date, alacor, in the amount of 1,875-3,125 cc./125 liters of water/ha, should be sprayed to prevent weed. This will make planting area safe from weed for 20-30 days. Before soybean starts flowering, weed killing may be done once again since after that, soybean will grow to cover the area and very small amount

of weed will appear. Killing weed after soybean starts podding will not or very unlikely to increase the yield that it is not worthy. If there is no weed killing spraying on the planting date, farmers may need to kill weed 3-4 times. According to a study, applying certain chemical to prevent weed after emergence is unlikely to work.

Soybean is a weak plant that cannot live without water. Each kilogram of dry soybean stem and seed needs over 600 litres of water unlike corn that needs only 350 litres. In addition, watering should be consistent during planting period. In hot weather, soybean should not be left unwatered for over 10 days. Lack of water during flowering or when a pod is growing will significantly decrease its yield. If planting is done in dry season, water should be let to enter the planting field every 7-10 days without water-logged. When the water is logged, it should be released from the field within 4 days. Once soybean is fully grown, it should be able to better withstand water logged.

7) Soybean Disease

There are many kinds of soybean disease. Each one shows acute symptom in different places, that is some disease is acute in certain places but not the others. An outbreak of particular disease is a challenge of planting soybean in Thailand. As long as such disease problem is not fixed, farmers tend to hesitate to plant soybean and turn to their kinds of plants with less problems. To discuss all kinds of disease especially in details may be too trite, so important and impact-causing kinds of disease will be hereby discussed.

(1) Rust

It emerges from fungus called *Phakopsora pachyrhizi* Syd. This disease spreads out in tropical countries but not in the USA. It is found every soybean planting area in Thailand. However, in some years, it may not emerge depending on humidity and temperature. If the humidity and temperature is high, such disease will spread out acutely.

A symptom starts from the lower leaves when soybean starts flowering or slightly before flowering and spreads to the upper leaves. At an early stage, small brown spots under the leaves will appear and increase. These spots have color and shape like that of iron rust. If there are a lot of them, leaves will fall down. Soybean with this disease will give lean pods and small seeds. Prevention can be done by spraying chemical after 20-30 days of planting by spraying 45-60 g./20 litres of water of Manzate D 80 or 60g./20 litres of water of Zineb every 15 days despite of the fact that symptom does not appear. Spraying should be stopped when soybean starts podding. Another way of prevention is planting a variety that is resistant to this disease e.g. SJ.4, SJ.5, etc. To date, there is no variety that is truly resistant to this disease.

(2) Anthracnose

It emerges from fungus called *Colletotrichum Dematium f. Truncatum*. When spreading out, it can be as acute as rust disease. Dark brown spots will be found on the leaves, stems and pods. The spots will be 2-10 mm. large. Also, brown-black circles will be found on branches. Seeds will be lean and crumple. Prevention can be done by refraining from planting soybean from a field that used to have this outbreak and not using seeds from a stem or field that used to have this outbreak and by spraying Benomyl 50% W.P. and Manzate-D 80% W.P.

(3) Bacterial Blight

It emerges from bacteria called *Pseudomonas Glycinea* Coerper. This disease spreads out widely almost everywhere that soybean is planted but it may or may not be acute. It is acute when the weather is cold or the rain is heavy. Rectangular small spots will appear on the leaves. The spots are brown and appear between vein. It should be noted that soybean popularly planted in Thailand (SJ.1, SJ.2 and SJ.4) tends to have this disease but generally it is not acute or cause slight damage. Prevention can be done by planting with seeds that is safe from this disease since this disease is seedborne. Also, disease-resistant variety should be planted.

(4) Bacterial Pustule

It emerges from bacteria called *Xanthomonas Phaseoli* Var. *Sojensis* (Hedges). Circular small red-brown spots with yellow-green outer line will be found on the leaves. These spots are gibbous and appear under the leaves called pustule. This disease widely spreads out everywhere and every country that soybean is planted but it causes slight damage. Prevention can be done by planting disease-resistant variety. Clark 63 and Orba is effective at resisting this disease. Prevention by spraying chemical is unlikely to work.

(5) Downy Mildew

It emerges from fungus called *Peronospora Manshurica* (Naoum.) Syd. This outbreak is found in particular provinces e.g. Chiang Mai, Loei, etc. The outbreak is not acute. Small light green spots that will turn its color into grey or brown-black will be found on the leaves. There are a lot of races in this disease. Prevention can be done by planting disease-resistant variety. At present, there is a research conducted in Thailand to find out variety that is resistant to this disease. Nakhon Sawan 1 can barely resist this disease.

(6) Soybean Mosaic

This disease is caused by virus called Soja Virus 1 which is seedborne and may spread out by aphids as carriers. Soybean with this disease will have crumple leaves, dark color between vein, undersized stems, short leafstalk and small pods. This disease is seedborne, hence; diseased seedling should be destroyed prior to harvesting. Prevention can be done by planting with seeds from stems or field that are safe from this disease.

The aforementioned diseases are widely found. Some may be acute in one place but not in the others. Apart from such disease, there are others that damage soybean e.g. stemrot disease, root and stub rot disease, brown spot leaves disease, frog-eye spot disease , purple seed stain disease, etc.

8) Insects harming soybean

There are over 10 kinds of insects that harm soybean but there are only 5-6 following ones that are detrimental:

(1) Beanfly

It is a worm to develop into a fly called *Melanagromyza Sojae*. It is a black insect with transparent wings, a length of 0.3 cm. and lay eggs at the stub or leaf stalk of soybean. An egg hatches into a light yellow worm burrowing into a stem causing soybean to cease growing. If it reaches the top of the stem, the top will be flaccid, stop growing but will start branching out making its node short and decrease the yield. This kind of worm can be destroyed by spraying chemical such as Omethoate, Monocrotophos (Azodrin), Triazophos (Hostathion 40 EC) after mixing with water as recommended and spray after soybean has emerged for 7-10 days. Then, respraying should be done once or twice within 7 days.

(2) Leaf Roller

It is a worm to develop into many types of moth i.e. *Hedylepta Indica*, *H. Diamenalis* and *Archips Micaceana*. This worm will web by using soybean leaves as its habitat and eat soybean leaves until there is only vein remaining. Prevention can be done by spraying Monocrotophos, Methyl Parathion, EPN and Methomyl.

(3) Leaf Miner

It is a worm to develop into a moth called *Aproaerema Modicella* which will burrow under the leaves' surface and eat the leaves until they are misshaped. This will make soybean undersized and cease growing. Prevention chemical is Omethoate, Monocrotophos and Triazophos.

(4) Aphid

Aphid or *Aphis Glycines* harms soybean since it becomes seedling until it starts to pod. Aphid is found a lot in dry season causing seedling to frizzle and cease growing, damaged pods and lean seeds. Prevention can be done by spraying Triazophos, Methamidophos, Omethoate and Monocrotophos.

9) Harvesting and Threshing Soybean

Soybean will be ripe and ready to be harvested after 75-110 days of planting (depending on its variety). When it is ripe, a pod will become yellow and brown. Also, leaves become yellow or brown and fall from its stems. Harvesting can be done by cutting the stem to the soil level and gather it to a threshing area. If threshing is done by a machine, it can be done in the planting field in order that stems and pods will remain in the soil.

Threshing soybean can be conducted by using animals to step on it in the threshing area or using a tractor to overlay on it. If the amount of soybean is small, threshing can be done by putting it in a gunny sack and hit it with a woodstick. This process will work only if the soybean is completely dry. After threshing, seeds cleaning should be done and put in a sack or sun-dry the seeds until they are completely dry. Storing seeds when they are still moist will make them moldy and lose its germination faster.

10) Storing and Finding Soybean Seed

Soybean seed loses its germination very fast. If storing over a year, it will lost its germination by 50% maximum. Therefore, seeds are an important problem for farmers. Farmers cannot find good seeds suitable for planting unless farmers can plant soybean in both rainy and dry season. This means only if they can store seeds harvested from one season to plant in the other or they can purchase seeds which are planted in another season from other areas or provinces, for example, farmers in Chiang Mai who will plant soybean after rice planting season (dry season) may purchase seeds from farmers in Sukhothai or Nakhon Sawan who planted soybean in rainy season. However, these seeds are not considered good seed variety since they are of mixed variety, there are damaged seeds or seeds with disease since they are produced for graining rather than seeding purpose.

If farmers wish to store their own seeds to plant in the following year, it may be possible. Storing seeds in a cold and less airy place can delay germination loss. The best way for storing is store in a cold storage with low temperature and humidity. This way can store seeds for over 4-5 years with slight germination loss. It is certain that farmers cannot find a cold storage, thus, they have to turn to another way. According to an experiment, if completely dry seeds (with a humidity rate of 12%) were put in a bucket and sealed firmly or put in a vacuummed plastic bag, seeds can be stored over a year with slight germination loss.

At present, Department of Agricultural Extension plays an important role in producing and procuring soybean seeds. In this manner, propagation center is initiated throughout every region of the country to procure or distribute seeds to farmers. Also, Seed producing corporations wants to produce and sell seeds to farmers but they tend to produce seeds of short life-span variety since the cost is low and their products will be used up fast.

2.2 Soybean Situation in 2017

1) Global Situation

Production

In 2012/13 – 2016/17, the global soybean yield increased by 6.63% a year. In 2016/17, the total yield was 351.25 million tons, higher than 313.71 million tons in 2015/16 by 11.97%. Top 3 important producers of the world total yield, which is 288.82 million tons, were the USA, Brazil and Argentina which is the total of 82.23% of the global production.

Marketing

(1) Demand

In 2012/13 - 2016/17, soybean demand for oil production is 5.79% a year. In 2016/17, there is a demand of 288.40 million tons, increased from 274.93 million tons in 2015/16 by 4.90%. Countries with the most demand are China and the USA respectively. Both countries had higher demand compared to that of 2015/16. The year-end stock in 2012/13 - 2016/17 increases by 14% a year with 94.86 million tons in 2016/17 which is higher than 77.74 million tons in 2015/16 by 22.02%.

(2) Export

In 2012/13 - 2016/17, the global soybean export increased by 9.96% a year. In 2016/17, there was an export amount of 147.46 million tons, higher than 132.46 million tons in 2015/16 by 11.32%. Important exporting countries were in North and South American continent namely; Brazil, the USA and Argentina. These 3 countries have the total export amount of 129.19 million tons which is the total of 87.61% of the global export.

(3) Import

In 2012/13-2016/17, the global soybean import increased by 9.92% a year. In 2016/17, there was an import amount of 143.61 million tons, higher than 133.33 million tons in 2015/16 by 7.71%. China is the largest importing country with the amount of 92.50 million tons which is 64.42% of the global import since its domestic production cannot meet its domestic demand. Thailand is the fifth-largest importing country. In 2016/17, Thailand imported the amount of 3.08 million tons or 2.14% of the global import.

(4) Price

In 2012/13 – 2016/17, soybean price in every important market tended to decrease but the price in 2016/17 slightly increased from that of 2015/16. In the US market, the price continuously decreased by 11.24% a year but in 2016/17, the price was USD 351/ton, higher than USD 346/ton in 2015/16 by 1.45%. In Brazil market, soybean price tended to decrease by 9.21% a year. When comparing the price in 2016/17 and 2015/16, it is found that the price slightly increased by 0.79% from USD 382/ton to USD 385/ton owing to the fact that the yield and the year-end stock tended to continuously increase causing the price to reduce.

2) Thailand Situation

Production

In 2013/14 – 2017/18, soybean planting area and soybean yield tends to decrease by 12.14% a year and 10.50% a year respectively. In 2017/18, there is a planting area of 0.0216 million ha, and a yield of 38,079 tons. In 2016/17, there was a planting area of 0.02192 million ha, and a yield of 37,765 tons. The planting area decreased by 1.36% but the yield increased by 0.83%. The reasons to the decrease of planting area are soybean yield is lower than that of the comparable plant and labor shortage. The reason why yield per ha in 2013/14 - 2017/18 increases by 0.84% a year is because drought occurred in the past few years. In 2017/18/61, the amount of yield per ha is 1,768.75 kg., higher than 1,731.25 kg. in 2016/17 by 2.17%.

Marketing

(1) Domestic Demand

In 2013 - 2017, soybean grain demand continuously increased by 15.91%. In 2017, there was a domestic demand of 2.94 million tons, lower than 2.99 million tons in 2016 by 1.67%. Soybean grains demand over the past 5 years has increased by 6.78% and 50.38% of the total demand respectively in accordance with the growth of oil extracting and food processing industry. Demand for planting decreased in accordance with plating area.

(2) Export

Most of Thailand's export is exporting non-GMO soybean grains which were produced within the country. In 2013 – 2017, the amount of export ranges from 1,989 to 11,595 tons. In 2017, it is expected to have imported 6,500 tons. Major exporting markets are in Asia and Nigeria.

(3) Import

Thailand relies on soybean grains import for 98.57% of the total demand. In 2013 – 2017, the import amount increased by 16.61% a year. In 2017, it is expected to have imported 2.90 million tons. Major countries soybean were imported from are Brazil, the USA, Argentina and Canada.

(4) Price

In 2016-2017, soybean grains and soybean oil domestic price fluctuates in the same way of that of the global price as follows:

- 1) Mixed-class soybean grain price sold by farmers tended to decrease by 6.33% in 2017 with the price of USD 0.433/kg., which is higher than USD 0.410/kg. in 2016 by 1.59%.
- 2) Koh Si Chang Port soybean grain import price tended to decrease by 6.58% in 2017 with the price of USD 0.445/kg., which is higher than USD 0.413/kg. in 2016 by 3.64%.
- 3) Refining soybean oil wholesale price tended to decrease by 7.53% in 2017 with the price of USD 1.131/kg., which is lower than in 2016 by 1.54%.

2.3 Soybean Trend in 2018

1) Global Soybean Trend

Production

In 2017/18, it is expected that the global soybean grain yield will be 378.88 million tons, lower than 351.25 million tons in 2016/17 by 0.96% since soybean yield from major producer countries decreases. In 2017/18, it is expected that Brazil and Argentina will be able to produce 107.00 million tons and 57.00 million tons of soybean, lower than 114.10 and 57.80 million tons in 2016/17 by 6.22% and 1.38% respectively.

Marketing

(1) Demand

In 2017/18, it is expected that soybean grains demand for oil extraction will be 301.25 million tons, higher than 288.40 million tons in 2016/17 by 4.46% since soybean oil demand for consumption tends to increase especially in China, the main soybean seeds consumer, where there is a growth of animal feed and livestock industry.

(2) Export

In 2017/18, it is expected that the global soybean export will be 150.97 million tons, higher than 147.46 million tons in 2016/17 by 2.38%. Major exporting countries are Brazil, the USA and Argentina. Moreover, the soybean global stock will be 96.05 million tons, higher than 94.86 million tons in 2016/17 by 1.25%.

(3) Import

In 2017/18, it is expected that the global soybean import will be 148.64 million tons, higher than 143.61 million tons in 2016/17 by 3.50%. China will be the largest importer with the amount of 95.00 million tons which is 63.93% of the global import.

(4) Price

In 2017/18, it is expected that the global soybean seed price will be similar to the previous year. Prices in Brazil and Argentina will slightly increase since yield from both countries decrease. While in the US market, the price will slightly decrease since yield from the USA increases.



2) Thailand Soybean Trend

(1) Production Situation

Soybean planting area and yield continuously decrease since caring after planting is complicated and requires a great deal of labor. Also, soybean yield is less than those of other comparable plants such as animal feed corn, sweet corn, etc. It is expected that in 2018/19, there will be planting area of 0.021 million ha, yield of 37,991 tons and yield per ha of 1,800 kg.

(2) Markets

(1) Domestic Demand

In 2018, it is expected that there will be a demand of 2.93 million tons, consisting of a 1.02% of domestic yield and a 98.98% being imported of the total demand

(2) Export

In 2018, it is expected that the export amount will be 8,000 tons, higher than 6,500 tons in 2017 by 23.08%. This amount is contributed to exporting non-GMO soybean seeds which were harvested within the country and major exporting markets are in Asia.

(3) Import

Soybean's import amount is likely to be static in accordance with domestic industrial demand. It is expected that in 2018, the import amount will be 2.90 million tons since the price has increase.

(4) Price

In 2018, it is expected that the price of soybean grain sold by farmers will slightly increase.

(3) Factors Affecting Soybean Production

Government sector has promoted soybean planting. Ministry of Agriculture and Cooperatives has approved budget from Soybean Production Development Fund in total of USD 0.718 million to promote Soybean-Planting-After-Rice-Planting-Season project. This project aims to promote farmers to plant soybean in Dry Season instead of planting rice, enhance soil condition and enhance products' quality to be accordant with market's demand. Moreover, government and private sectors have worked together to promote soybean planting after rice planting season to increase yield called planting Soybean-Planting-After-Rice-Planting-Season project, Civil State For Food Security in Udon Thani and Si Sa Ket's Rice Field. Private sectors such as Bang Sue Chia Meng Rice Mill Co.,Ltd., Siam Kubota Co.,Ltd., etc. have cooperated in this project. This project is expected to reduce production cost and enhance yield's quality and soybean's yield per ha.

Table 2.1 Balance of the Global Soybean Seed in 2012/13 - 2017/18

Unit: million tons

Items	2012/13	2013/14	2014/15	2015/16	2016/17	Growth Rate (Percentage)	Expected Amount in 2017/18
1. Yield	268.45	282.75	320.01	313.71	351.25	6.63	347.88
2. Import	97.19	113.07	124.36	133.33	143.61	9.92	148.64
3. Export	100.80	112.78	126.13	132.46	147.46	9.96	150.97
4. Demand for Oil Extraction	231.52	242.92	264.35	274.93	288.40	5.79	301.25
5. Year-End Stock	55.35	61.59	77.52	77.74	94.86	14.00	96.05

Source: Oilseeds, World Markets and Trade. USDA Foreign Agricultural Service, October 2017

Table 2.2 Soybean Seed Price in the Global Market in 2012/13 - 2016/17

Unit: USD/ton

Items	2012/13	2013/14	2014/15	2015/16	2016/17	Growth Rate (Percentage)	Expected Amount in 2017/18
1. USA	537	487	356	346	351	-11.24	343
2. Brazil (F.O.B)	538	514	388	382	385	-9.21	386
3. Argentina (F.O.B)	543	517	401	375	376	-10.02	378
4. Rotterdam (C.I.F)	592	542	407	396	404	-10.22	399

Source: Oilseeds, World Markets and Trade. USDA Foreign Agricultural Service, October 2016

Table 2.3 Planting Area, Yield and Thailand's Yield per Hectare in 2013/14 – 2018/19

Items	2013/14	2014/15	2015/16	2016/17	2017/18	Growth Rate (Percentage)	Expected Amount in 2018/19
1. Planting Area (million hectare)	31,360	37,920	26,720	21,920	21,600	-12.14	0.132
Wet Season	9,920	11,840	10,080	8,800	8,640	-5.40	0.052
Dry Season	21,440	26,080	16,640	13,120	12,960	-15.37	0.080
2. Total Yield (tone)	53,358	58,295	42,395	37,765	38,079	-10.50	37,991
Wet Season	19,599	22,806	17,950	17,255	16,964	-5.52	16,603
Dry Season	33,737	35,489	24,445	20,510	21,115	-13.80	21,388
3. Yield per ha (kg.)	1,701	1,537	1,587	1,723	1,763	0.84	1,799
Wet Season	1,976	1,926	1,781	1,961	1,963	-0.53	1,996
Dry Season	1,574	1,361	1,469	1,563	1,629	0.87	1,671
4. Planting Area per Household	0.997	0.837	0.864				
Wet Season	0.830	0.805	0.822				
Dry Season	1.099	0.853	0.890				

Source: Office of the Agricultural Economics

Table 2.4 Balance of Thailand Soybean Seed in 2013 - 2018

Unit: ton

Year	Domestic Production	Import	Total (Supply)	Domestic Demand			Export	Total (Demand)
				Oil Extraction	Seed	Processing		
2013	65,112	1,678,678	1,743,790	1,517,133	4,418	220,250	1,989	1,743,790
2014	56,565	1,898,295	1,954,860	1,524,088	3,745	415,432	11,595	1,954,860
2015	53,439	2,557,384	2,610,823	1,718,168	4,055	879,283	9,317	2,610,823
2016	42,302	2,957,729	3,000,031	1,970,155	2,987	1,021,412	5,477	3,000,031
2017 ^{1/}	41,898	2,900,000	2,941,898	1,852,520	2,841	1,080,037	6,500	2,941,898
Growth Rate (Percentage)	-11.06	16.61	15.89	6.78	-10.05	50.38	17.57	15.89
2017 ^{2/}	40,994	2,900,000	2,940,994	1,852,826	2,647	1,077,521	8,000	2,940,994

Remarks: ^{1/} Basic Information ^{2/} Expected Amount

Source: Office of the Agricultural Economics

Table 2.5 Thailand's Soybean Products Price in 2013 - 2017

Unit: USD/kg.

Items	2013	2014	2015	2016	2017	Growth Rate (Percentage)
1. Farmer gate price	0.594	0.557	0.451	0.410	0.433	-6.33
2. Import Price at Koh Sri-chang's Port	0.605	0.568	0.438	0.413	0.445	-6.58
3. Futures Price at Chicago Market	0.518	0.459	0.348	0.365	0.353	-6.91
4. Refining Soybean Oil Wholesale Price ^{1/}	1.630	1.542	1.300	1.104	1.131	-7.53

Remarks: ^{1/} VAT included, packaging cost excluded

Source: Office of the Agricultural Economics

Table 2.6 Thailand's Soybean Seeds Domestic Demand in 2013 - 2017

Unit: ton

Items	2013	2014	2015	2016	2017	Growth Rate (Percentage)	Expected Amount 2018
Demand	1,741,801	1,943,265	2,601,501	2,994,514	2,935,398	15.91	2,932,994
1. Oil Extraction	1,517,133	1,524,088	1,718,168	1,970,115	1,852,520	6.78	1,852,826
2. Processing	220,250	415,432	879,283	1,021,412	1,080,037	50.38	1,077,521
3. Seed	4,418	3,745	4,055	2,987	2,841	-10.50	2,647

Source: Office of the Agricultural Economics

2.4 Measures and Policy

1) Soybean Seeds Import Management in 2018

For the purpose of managing imported soybean products pursuant to the resolution of the Oil Seed Plant and Vegetable Oil Committee in the meeting no. 3/2017 dated November 21, 2017, it was resolved as follows:

Approve management of soybean seed import in 2018 under WTO's framework as follows:

1.1 Candidates for soybean seed importer in the total of 6 association and 18 companies are:

- 1.1.1 Soybean and Rice Bran Oil Processor Association
- 1.1.2 Thai Feed Mill Association
- 1.1.3 The Feedstuff Users Promotion Association
- 1.1.4 Thai Livestock Association
- 1.1.5 Agricultural Products Trader with Neighboring Countries Association
- 1.1.6 Agricultural Products and Processing Industry Association
- 1.1.7 Green Spot Co.,Ltd.
- 1.1.8 Lactasoy Co.,Ltd.
- 1.1.9 Thai Theparos Co.,Ltd.
- 1.1.10 Dairy Plus Co.,Ltd.
- 1.1.11 Thai Chim Co.,Ltd.
- 1.1.12 Kikkoken LLP
- 1.1.13 Universal Food Public Co.,Ltd.
- 1.1.14 Northern Food Complex Co.,Ltd.
- 1.1.15 Booncharoen Phokkaphan Co.,Ltd.
- 1.1.16 Tofusan Co.,Ltd.
- 1.1.17 Umenohana Co.,Ltd.
- 1.1.18 Sahachol Food Supplies Co.,Ltd.
- 1.1.19 Yan Wal Yun Co.,Ltd.
- 1.1.20 City Food Co.,Ltd.
- 1.1.21 Intouchthanagorn Co.,Ltd.
- 1.1.22 Toiyibun Foods Co.,Ltd.
- 1.1.23 Yamamori (Thailand) Co.,Ltd.
- 1.1.24 Nguan Chiang Food Industry Co.,Ltd.

The said 24 candidates shall apply for a certificate certifying that they are entitled to pay in-quota tax pursuant to an obligation under the Agreement of Agriculture under WTO to Department of Foreign Trade to declare to Thai Customs Department in import clearance. Import should be done within December 31, 2018.

In case where an applicant, who is a new importer and causing disqualification of an existing applicant, violates his obligation, the Soybean Seed Supervising Subcommittee 2017 - 2019 shall consider the case and notify the Oil Seed Plant and Vegetable Oil Committee.

1.2 The import candidates shall support and promote domestic soybean production by purchasing soybean seeds produced in the country at a market price but not less than the minimum price depending on its quality as followings:

Class of Soybean	๙Price at Planting Field (THB/kg.)	Bangkok Ex-factory Price (USD/kg.)
Oil Extraction	0.53	0.55
Animal Feed	0.54	0.56
Food Processing	0.60	0.62

2) Soybean-Planting-After-Rice-Planting-Season Project under the support of Soybean Production Development Fund

Department of Agricultural Extension has promoted a comprehensive soybean planting pursuant to Soybean-Planting-After-Rice-Planting-Season Project. There are 2 prototype fields under this project which are in Naan and Chiang Rai as follows, which aims to be a prototype for comprehensive soybean planting, starting from seed producing, distributing quality seed from one's community to produce soybean in dry season and enhance efficient soybean production by using agricultural machinery to drop seeds, and fertilizer, harvest, thresh, separate impurities, indicate humidity with humidity indicator and cleaning. Also, focusing on soybean production pattern pursuant to Good Agricultural Practices (GAP).

Cycle 1 Planting period December, 2017 - May, 2018, planting area 2,080 ha, 1,600 ha in Naan and 480 ha in Chiang Rai, harvesting period May-June, 2018, expected yield 3,250 tons

Cycle 2 Planting period December, 2018 - May, 2019, planting area 2,720 ha, 1,600 ha in Naan and 1,120 ha in Chiang Rai, harvesting period May-June, 2019, expected yield 4,250 tons

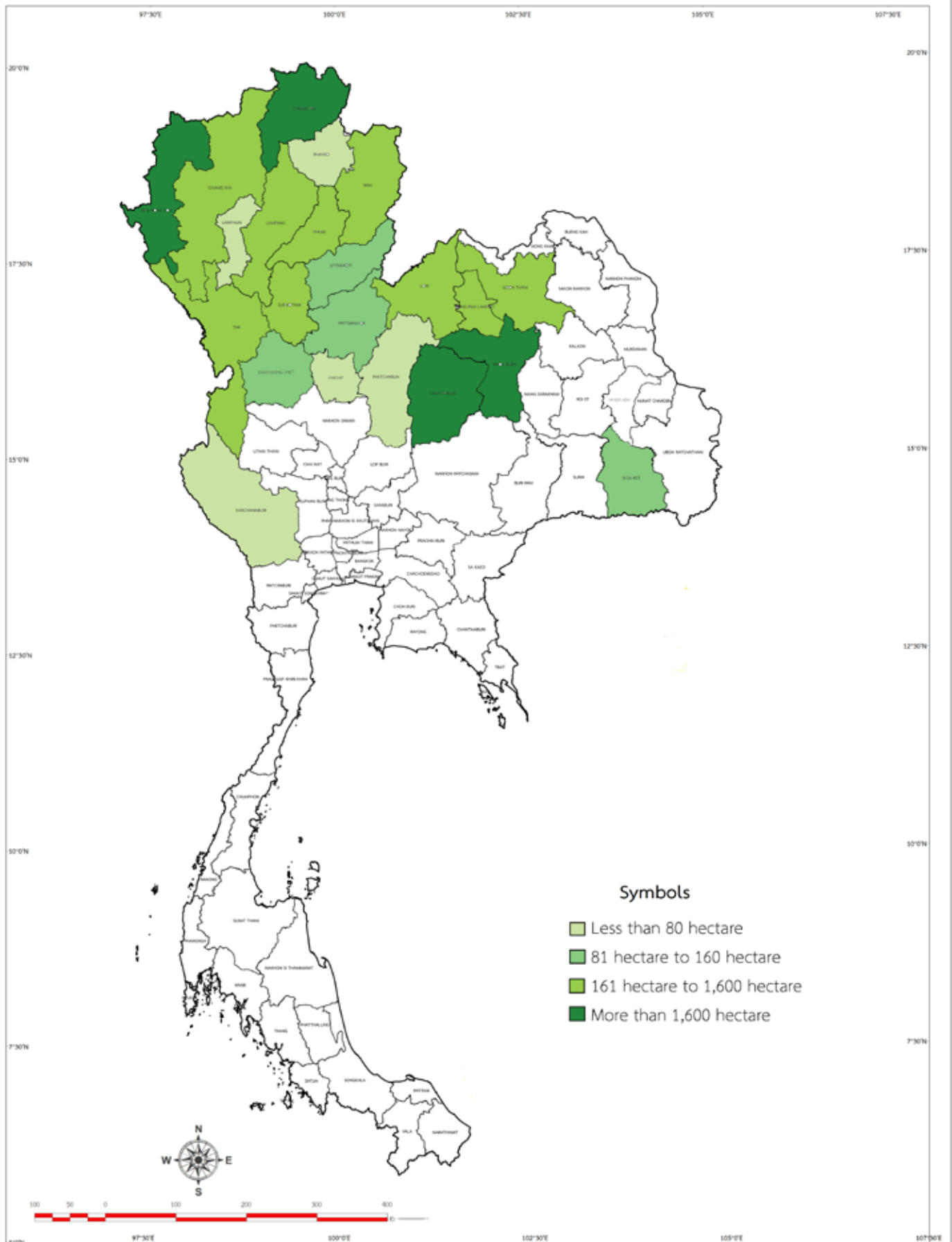
Expected benefit from Soybean Planting after Rice Promotion Project under the support of Soybean Production Development Fund are as follows:

2.1 Farmers plant soybean as an alternative to rice plating to enhance soil condition, break disease and insects' cycle, reduce the use of fertilizer in rice planting and reduce the use of water in dry season.

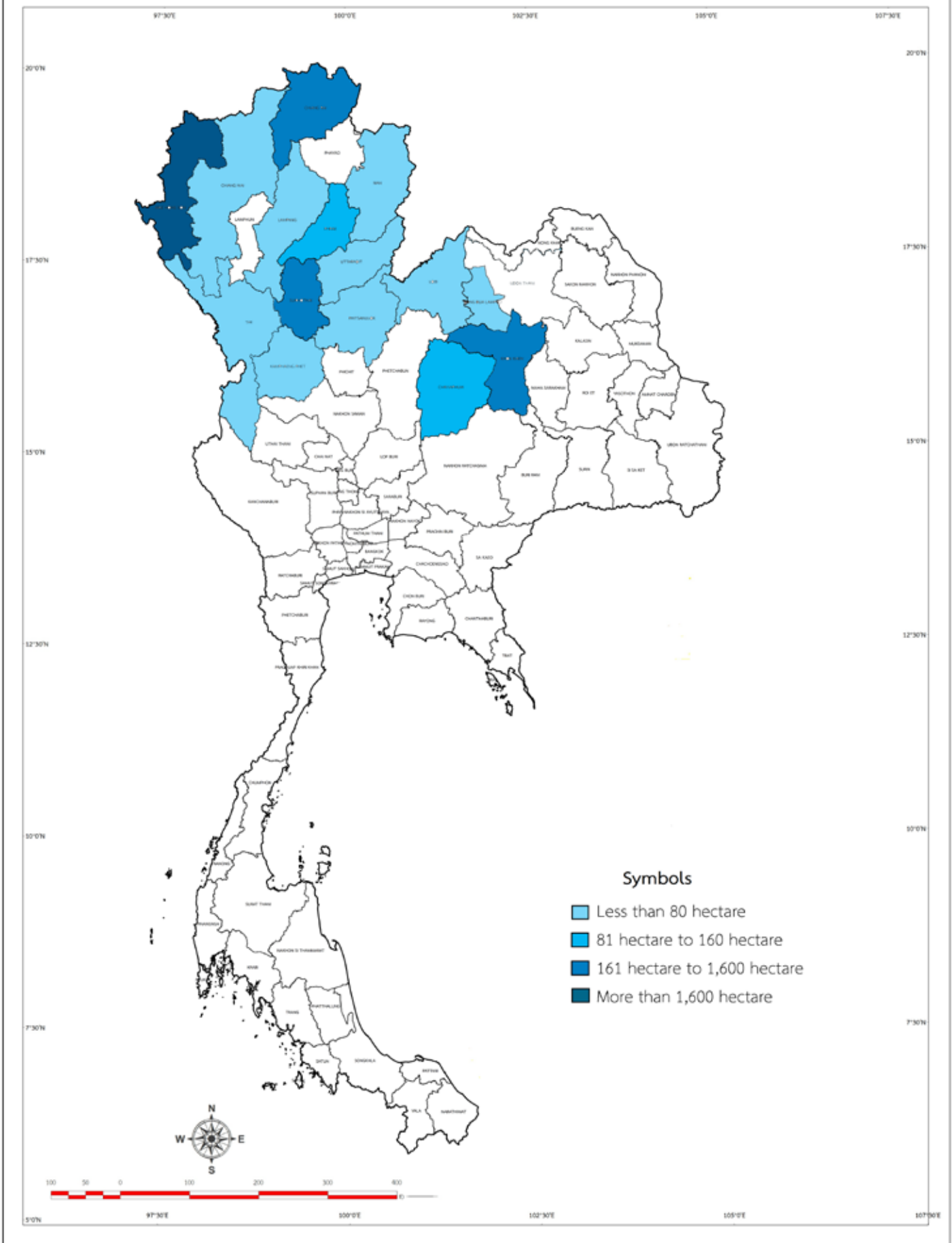
2.2 Maintain good quality soybean seeds in the farmer's production process and maintain good quality soybean products to serve market's demand.

2.3 Reduce cost and time used in soybean production's management.

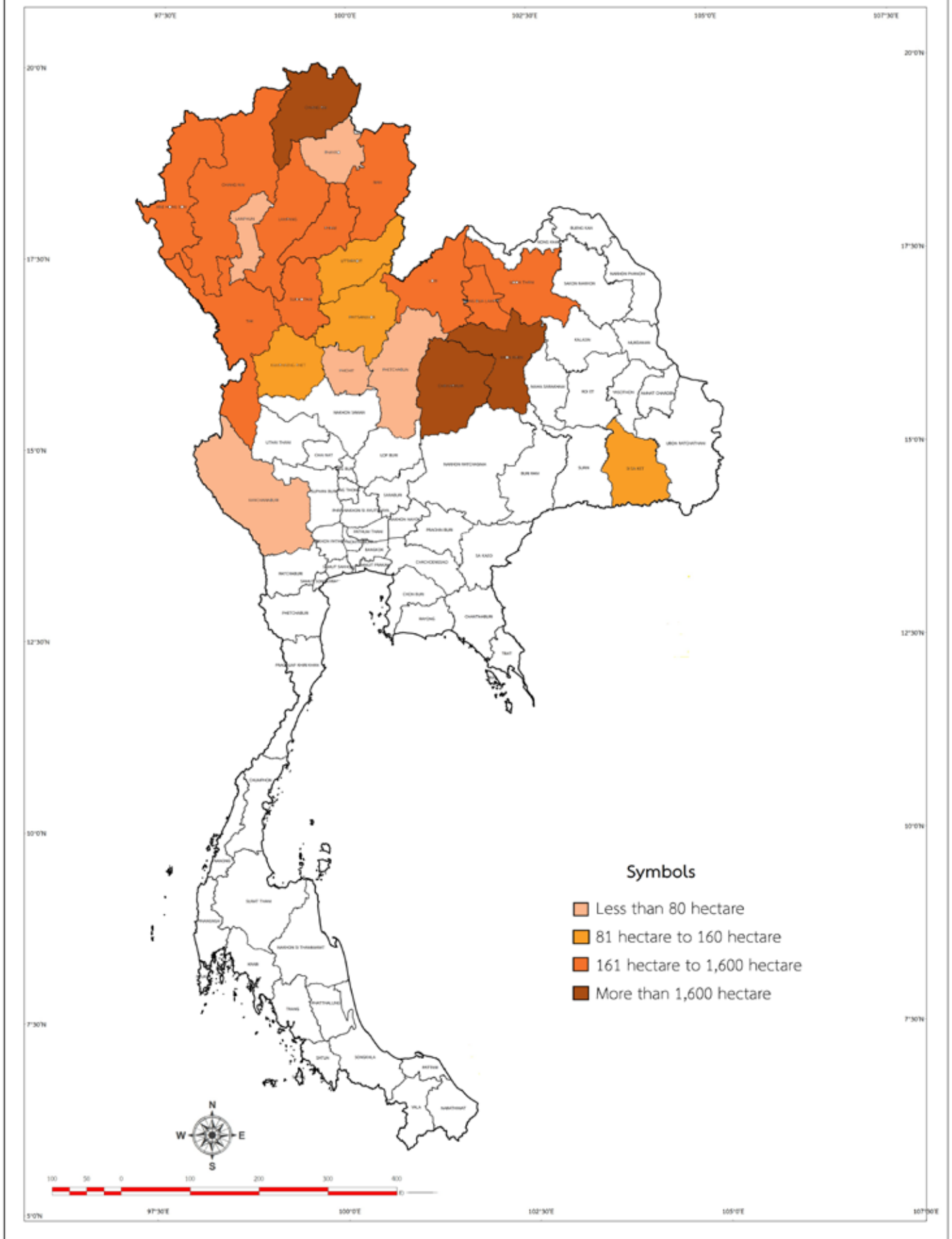
Picture 2.1 Domestic Soybean Planting Area Map



Picture 2.2 Soybean Wet Season Area Map



Picture 2.3 Soybean Dry Season Planting Area Map





Chapter 3 Methodology



3.1 Survey Method

3.1.1 Production Survey: surveyed on farmers who planted soybean in each soybean-planting village by using (1) random sampling survey method (2) census method in case where the sample village has a small number of farmers who planted soybean so it was easy to conduct consensus method. Such methods were used because the population are similar, data distribution is consistent and survey period is limited.

3.1.2 Cost of Production Survey: purposive sampling method is used since there are a lot of questions and details on the production cost questionnaire. Thus; cooperation from selected farmers is needed and random sampling method cannot be used.

3.2 Number of Sampling

3.2.1 Conducted a survey on farmers who planted soybean in 5 soybean-planting amphoe in Chiang Mai namely: Phrao, Mae Tang, Mae Rim, San Pa Tong and Hang Dong. Out of 11 soybean-planting amphoe in Chiang Mai, being 80% of the total of soybean-planting area. (Table 3.1)

3.2.2 Buying Places by interviewing buying places in Chiang Mai which are:

1) Mae Tang Agricultural Cooperative, Ltd., residing at 133, Moo 3, Tambol San Maha Phon, Amphoe Mae Tang, Chiang Mai 50150

2) Land Settlement Cooperative, Ltd., residing at 135 Moo 9, Tambol Khilek, Amphoe Mae Tang, Chiang Mai 50150

3) Agricultural Development Cooperative, Ltd., residing at 192, Moo 2, Tambol San Pa Yang, Amphoe Mae Tang, Chiang Mai 50330

4) Plant Seeds Research and Development Center, Department of Agriculture

5) Mae Rim Agricultural Cooperative, Ltd., residing at 38/5, Moo 4, Tambol Rim Tai, Amphoe Mae Rim, Chiang Mai 50180

6) San Pa Tong Agricultural Cooperative, Ltd., residing at 238, Moo 10, Tambol Yu Wa, Amphoe San Pa Tong, Chiang Mai 50120

3.2.3 Entrepreneur

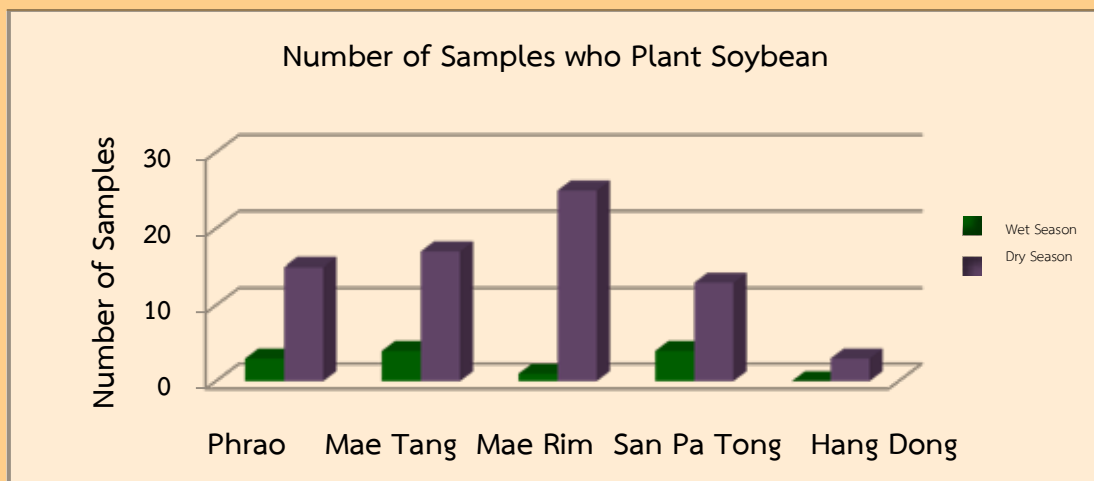
1) Rungruengpol Co., Ltd., residing 1, Moo 2, Tambol Kholng Hin Pun, Amphoe Wang Nam Yen, Sa Kaeo 27210



Table 3.1 Number of Samples of Soybean Farmers in Chiang Mai

Amphoe	Tambol	Village Number	Village Name	Number of Samples			Number of Samples (Production Cost)		
				Total	Wet Season	Dry Season	Total	Wet Season	Dry Season
Phrao	Nam Phrae	2	Baan Pa Ngiew	18	3	15	8	1	7
Mae Tang	Sop Poeng	6	Baan Tha Kham	4	0	4	0	0	0
		7	Baan Ton Laan	1	0	1	0	0	0
		9	Baan Nong Bualuang	5	2	3	5	2	3
		12	Baan Long	4	0	4	2	0	2
	San Pa Yang	3	Baan San Pa Teung	5	2	3	2	1	1
	Inthakin	4	Baan Muang Kam	2	0	2	2	0	2
Mae Rim	Saluang	2	Baan Saluang Nai	2	0	2	0	0	0
		4	Baan Gaad How	2	1	1	1	1	0
	San Pong	9	Baan Dong Nuea	6	0	6	2	0	2
	Khilek	4	Baan Sang	4	0	4	2	0	2
		5	Baan Ton Kham	12	0	12	2	0	2
San Pa Tong	Makham Luang	7	Baan Rong Nam	10	4	6	47	1	3
	Ban Mae	11	Baan Dong	7	0	7	3	0	3
Hang Dong	Nong Kaeo	2	Baan San Pu Loei	1	0	1	0	0	0
		3	Baan Muang Nga	1	0	1	0	0	0
		4	Baan Buak	1	0	1	0	0	0
Total				85	12	73	33	6	27

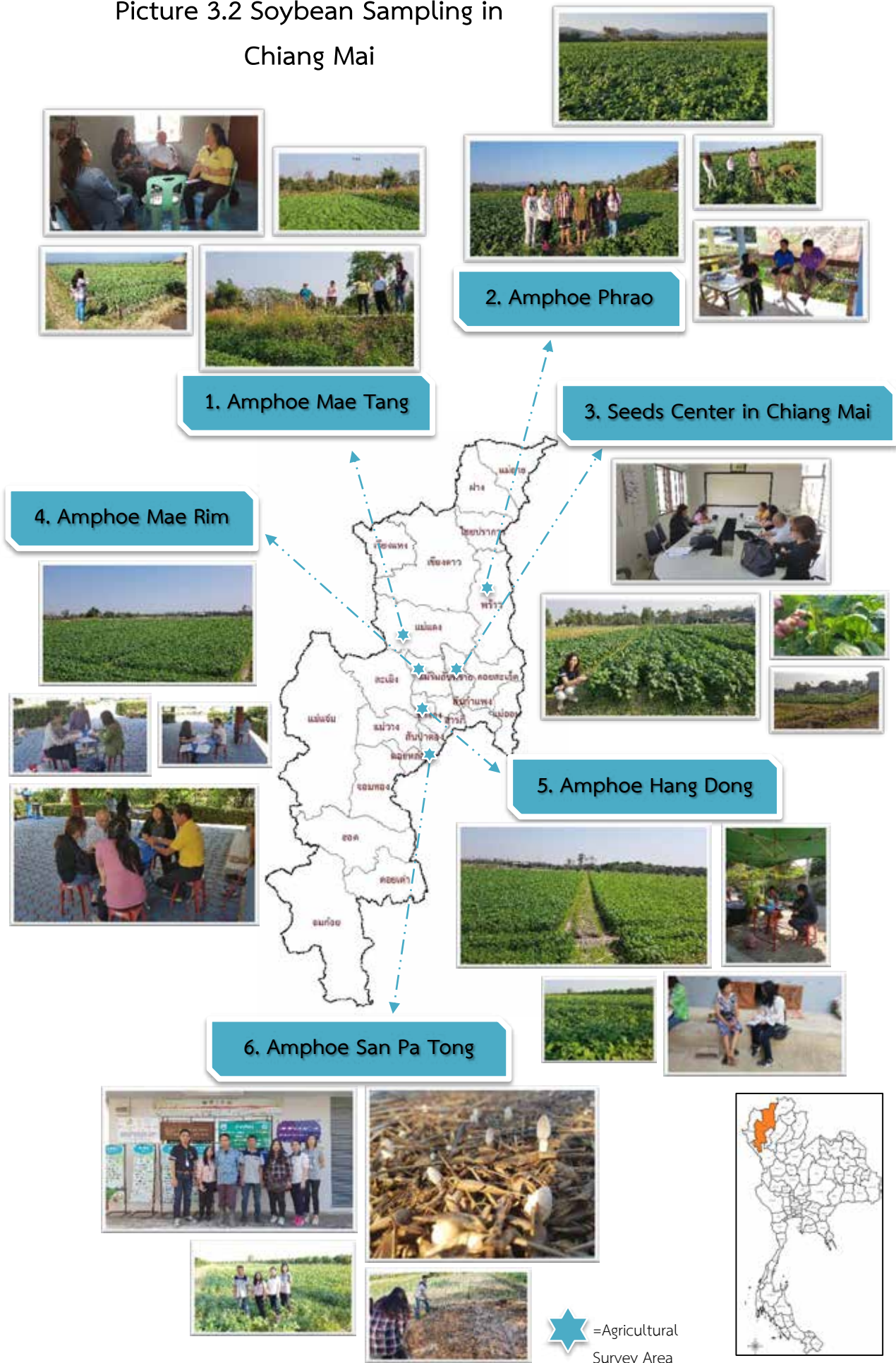
Remarks: After conducting a survey in Amphoe Doi Tao, it is found that there is a small numbers of samples of soybean farmers and thus, further survey cannot be conducted.



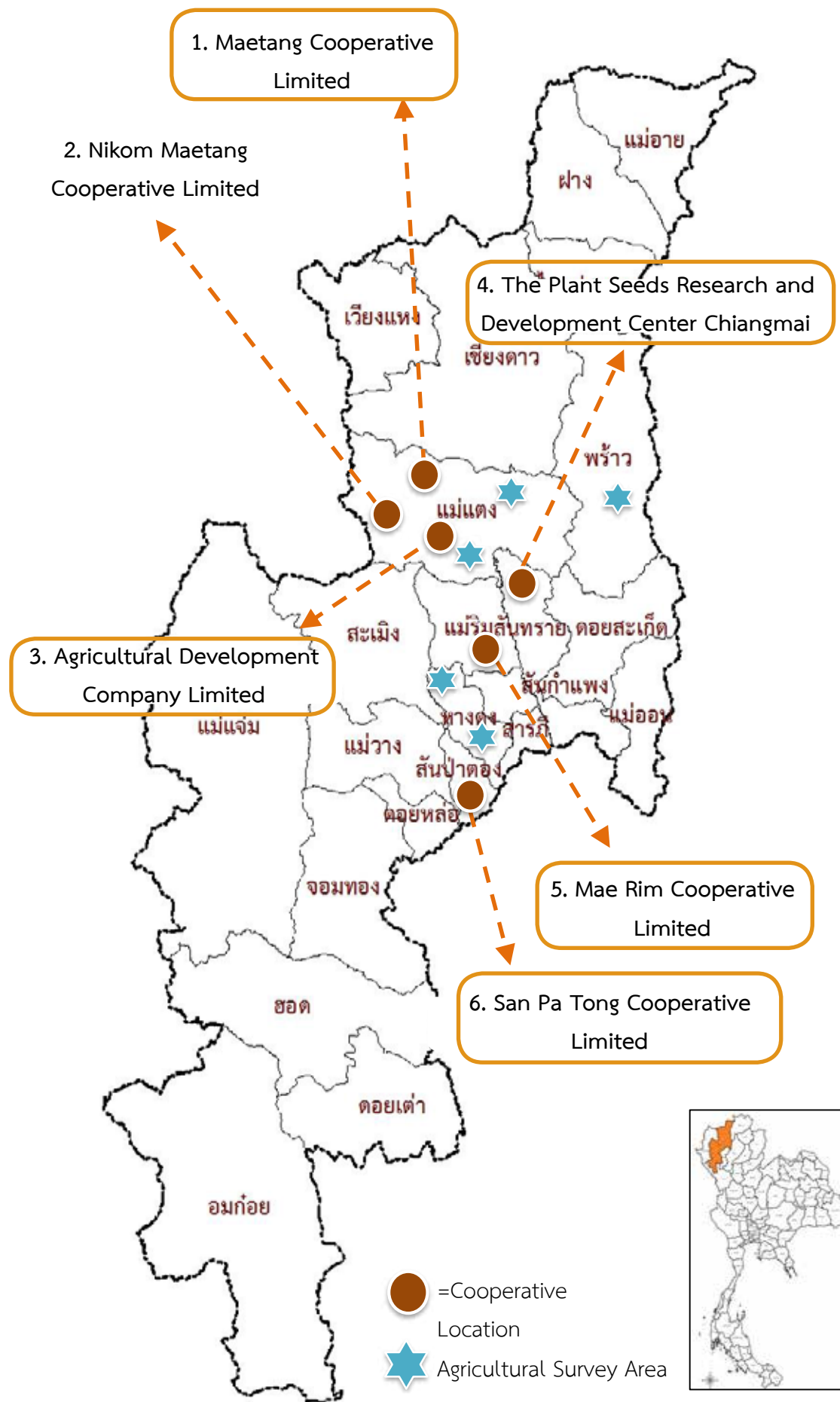
Picture 3.1 Number of Samples of Soybean Farmers Shown in Amphoe and Season



Picture 3.2 Soybean Sampling in Chiang Mai



Picture 3.1 Cooperative Location Diagram



3.3 Action Plan

Table 3.2 Action Plan

No.	Action	Period of Action							Remarks
		2017		2018					
		Nov	Dec	Jan	Feb	Mar	Apr	May	
1.	Research Preparation								
2.	Field Survey								
3.	Data Analysis								
4.	Data Conclusion								
5.	Report Drafting								
6.	Presentation								

3.4 Data Analysis

Quantitative Analysis is used as an analysis on economic cost and return which considers both cash cost and assessed cost as follows:

$$\text{Total Cost Per Ha} = \text{Fixed Cost} + \text{Variable Cost}$$

Total Cost means all cost and expenses used in production which is the sum of all variable costs and fixed cost both cash cost and assessed cost

Fixed Cost means land use cost, agricultural equipment depreciation cost and agricultural equipment opportunity cost. Land use cost is land rental fee calculated per an entire planting season both in cash and non-cash form. In case of land owned by a sample farmer, land use cost will be calculated as per land rental rate applied in such place.

Variable Cost is divided into 3 parts. The first one is labor cost namely; soil preparation cost, planting cost, caring cost and harvesting cost. The second one is materials cost namely propagation cost, fertilizer cost, insecticide and weed prevention cost, other substance, soil enhancing cost, fuels and lubricant cost, agricultural and used-up materials and agricultural equipment repairing cost.

Total Cost Per Kg.	= $\frac{\text{Total Cost Per Ha}}{\text{Yield Per Ha}}$
Yield Per Ha (Kg.)	= $\frac{\text{Total Yield}}{\text{Total Planting Area}}$
Return Per Ha (USD)	= Price at Planting Field x Yield Per Ha
Net Return Per Ha	= Total Cost Per Ha – Yield Per Ha
Net Return Per Kg.	= Total Cost Per Kg.– Price at Planting Field

3.5 Data Analysis Formula

Analysis starts from household calculation and entire-province calculation as follows:

As for household calculation, details are described below

1. Labor cost consisted of cost incurred from the following activities.

- soil preparation means expenses incurred from wage, soil preparation in every step that makes soil ready for planting such as plowing, ploughing up and over, gouging, etc.

- planting means expenses incurred from planting wage from bringing out seeds to planting field and planting seeds in the field.

- caring means expenses incurred from mowing, covering stub, loosening soil, applying fertilizer, spraying chemicals and watering.

- harvesting means expenses incurred from harvesting activities and other related activities. In case of soybean harvesting, both man and machinery can be used. Cost can be calculated in 2 manners which are calculation by area such as USD/Ha or calculation by yield such as USD/Ha.

2. Materials Cost consisted of propagation cost, manure or chemical fertilizer cost, insecticide and weed prevention cost, agricultural and used-up materials and agricultural equipment repairing cost.

3. Investment Opportunity Cost means expenses incurred from all items listed as variable cost as a return for the use of such production factors if they were to be used in other activities.

$$\text{OPC} = \text{TVC} \times \frac{M}{12} \times r$$

whereas

OPC = Opportunity Cost from Variable Cost (USD/Ha.)

TVC = Total Variable Cost per Ha

M = Production Period (Months) since Soil Preparation until Harvesting

R = Loan Interest Rate

4. Land Rental Fee means expenses incurred from land use for an entire planting season. If paid by yield, such yield shall be calculated into numbers. In case of land owned a sample farmer, it shall be calculated as per land rental rate applied in such place.

5. Asset Depreciation Expense means expenses incurred from appraisal of asset value distributing into each production stage for the useful life per rai. It will not be shown in cash. Depreciation calculation can be done in many methods. This study will use straight-line method which is the simplest and most popular one.

$$D = \frac{(BV - EV)}{N} \times \frac{M}{12} \times r \times U \times \frac{1}{A}$$

whereas

- D = Annual Depreciation Expense
- BV = Book Value of an Asset
- EV = Salvage Value of an Asset
- M = Period of Production (Month) from the Beginning of Production until Harvesting
- N = Useful Life
- U = Utilization Rate on Certain Plant
- A = Planting Area

6. Investment Opportunity Cost means expenses assessed from cost of procuring production factors such as agricultural equipment, buildings and construction in order to calculate opportunity cost from other activities if they were to be used instead. This study will use depreciation rate used by Bank for Agriculture and Agricultural Cooperatives.

$$OPI = \frac{(BV - EV)}{2} \times \frac{M}{12} \times r \times U \times \frac{1}{A}$$

whereas

- OPI = Investment Opportunity Cost
- BV = Book Value of an Asset
- EV = Salvage Value of an Asset
- M = Period of Production (Months) from the Beginning of Production until Harvesting
- r = Loan Interest Rate
- U = Utilization Rate on Certain Plant
- A = Planting Area

- | | | |
|-----------------------------|---|--|
| 6. Total Cost Per Kg. | = | $\frac{\text{Total Cost Per Ha}}{\text{Yield Per Ha}}$ |
| 7. Total Yield Per Ha (Kg.) | = | $\frac{\text{Total Yield}}{\text{Total Area}}$ |
| 8. Return Per Ha (USD) | = | Price at Planting Field x Total Yield Per Ha |
| 9. Net Return Per Ha | = | Total Cost Per Rai – Yield Per Ha |
| 10. Net Return Per Kg. | = | Total Cost Per Kg. – Price at Planting Field |

As for an entire-province calculation, details are described below

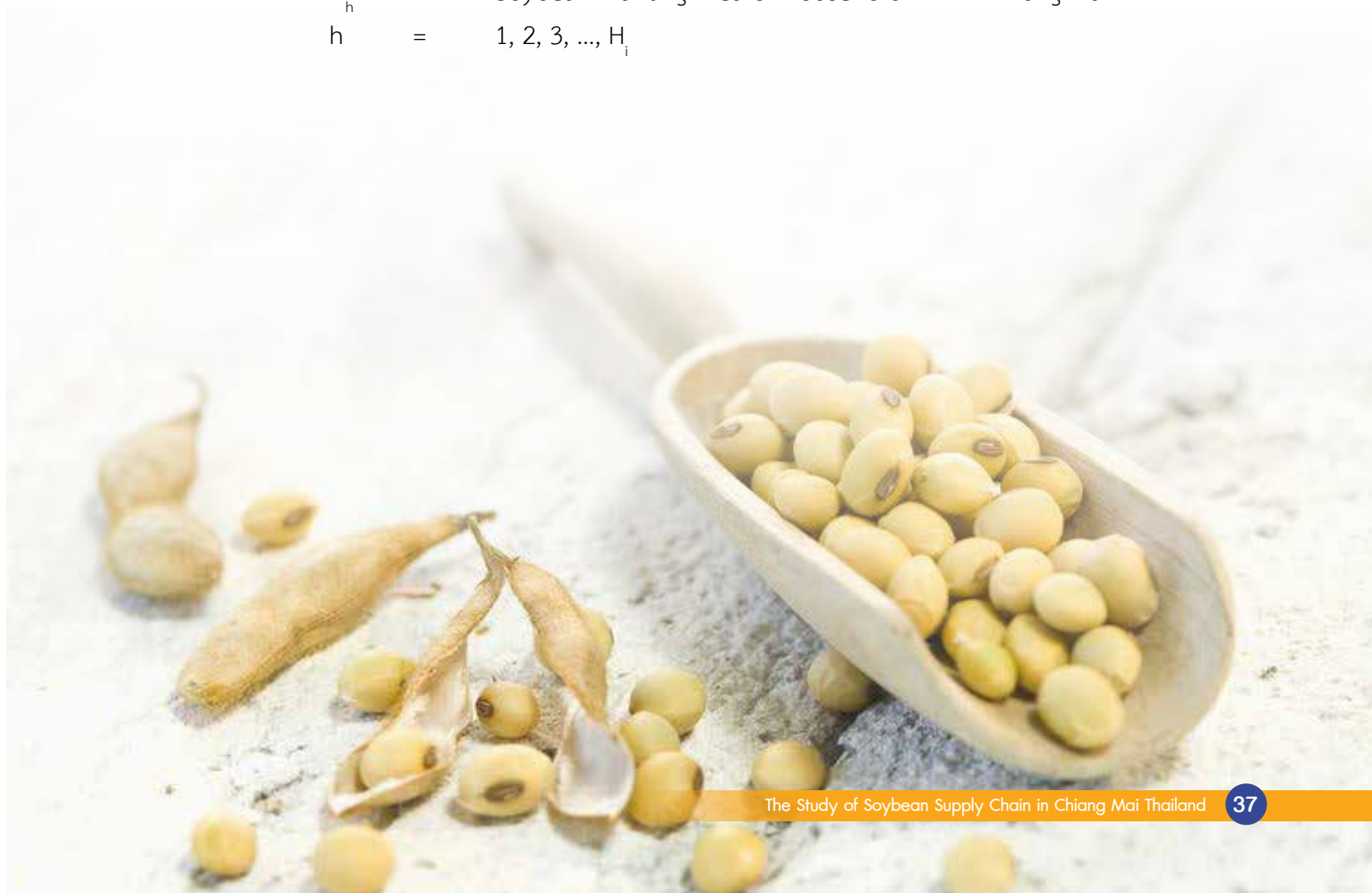
It is a weighted average of each item of costs incurred from each household by using the planting area of each household as a weight for each item.

Calculation Formula is:

$$\bar{C} = \frac{\sum_{h=1}^{H_i} C_h N_h}{\sum_{h=1}^{H_i} N_h}$$

whereas

- | | | |
|-----------|---|---|
| \bar{C} | = | Cost of Soybean Production in Chiang Mai |
| C_h | = | Cost of Soybean Production of Household “h” in Chiang Mai |
| N_h | = | Soybean Planting Area of Household “h” in Chiang Mai |
| h | = | 1, 2, 3, ..., H_i |



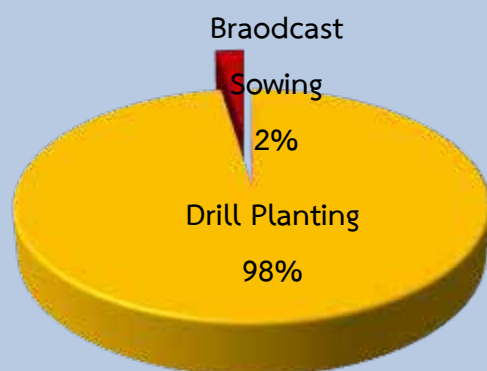


Chapter 4 Findings

4.1 Soybean Planting Information

1) Planting Method

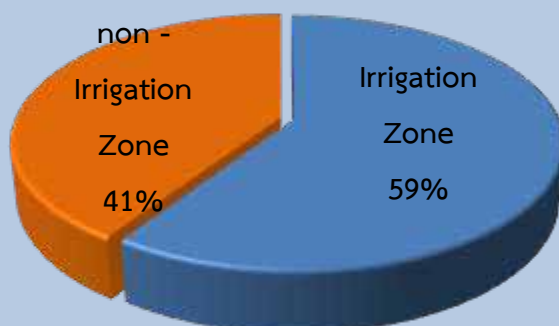
According to an interview conducted on farmers in 5 amphoe regarding soybean planting method, it is found that 98% of the farmers chose drill planting since it would enhance germination rate of soybean, while the rest 2% of the farmers chose broadcast sowing.



Picture 4.1 Percentage of Planting Method

2) Irrigation System

59% of farmers in all 5 amphoe planted soybean irrigation zone since they preferred to plant soybean in dry season which happens after rice planting season. Therefore, water from irrigation system is needed. The remaining 41% of the farmers planted soybean non-irrigation zone.

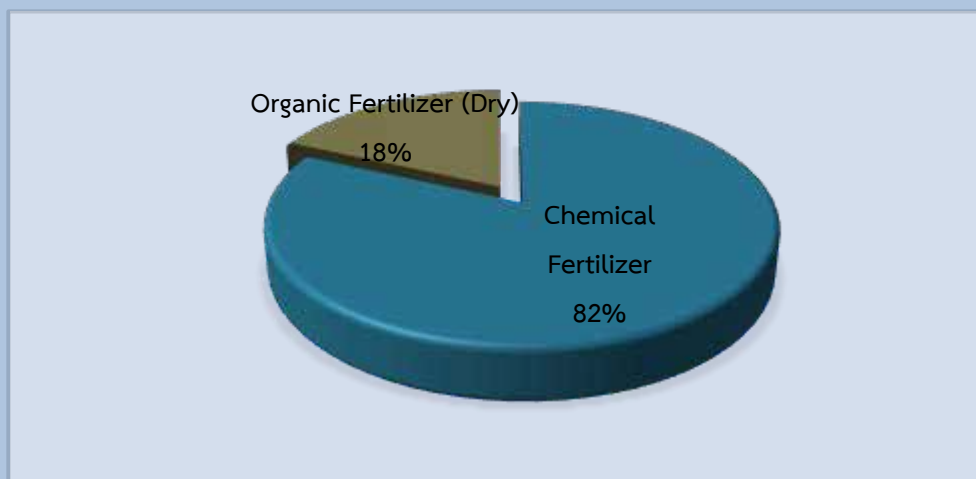


Picture 4.2 Percentage of Soybean Planting in Irrigation Zone

4.2 Soybean Production Factors

1) Fertilizer

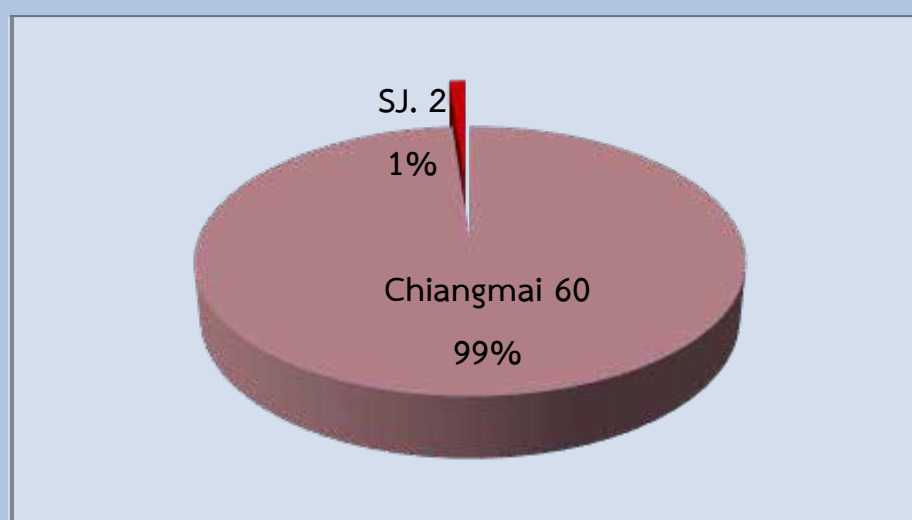
According to a sampling survey, it is found that soybean farmers used fertilizer at an amount of 168.75 kg. per ha. 82% of which is chemical fertilizer, while only 18% of which is organic fertilizer owing to the fact that chemical fertilizer is easier to find and provides faster results.



Picture 4.3 Percentage of Types of Fertilizer Used by Farmers

2) Seeds

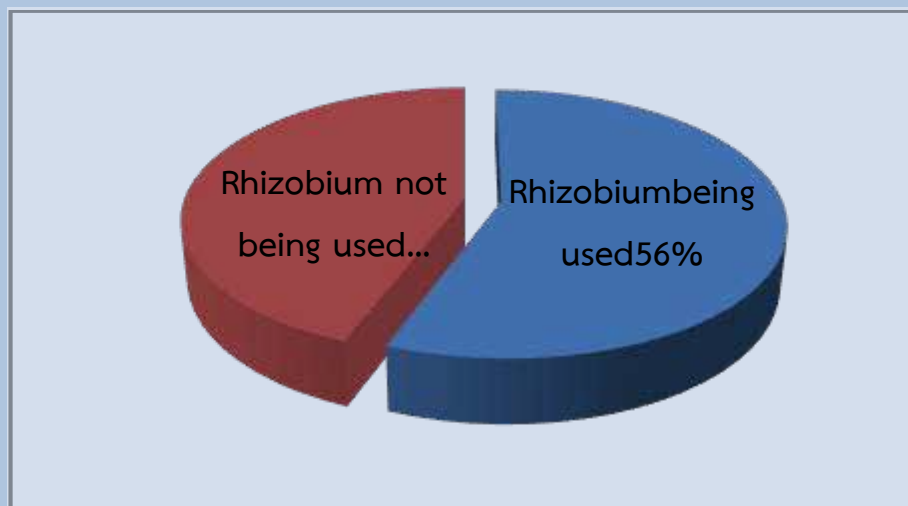
According to the sampling survey, the popular variety of soybean amongst farmers is Chiang Mai 60 which was planted by 99% of the samples due to the market demand. Only 1% of the samples planted SJ 2. Seeds used averagely for planting per ha is 112.5 kg.



Picture 4.4 Percentage of Soybean Varieties Popular among Farmers

3) Rhizobium Use

According to an interview conducted on soybean farmers in Chiang Mai regarding rhizobium use, it is found that 56% of the farmers used rhizobium in planting and 44% did not since they did not believe that it can enhance yield and cannot be used with seed-drilling machinery.



Picture 4.5 Percentage of Rhizobium Use

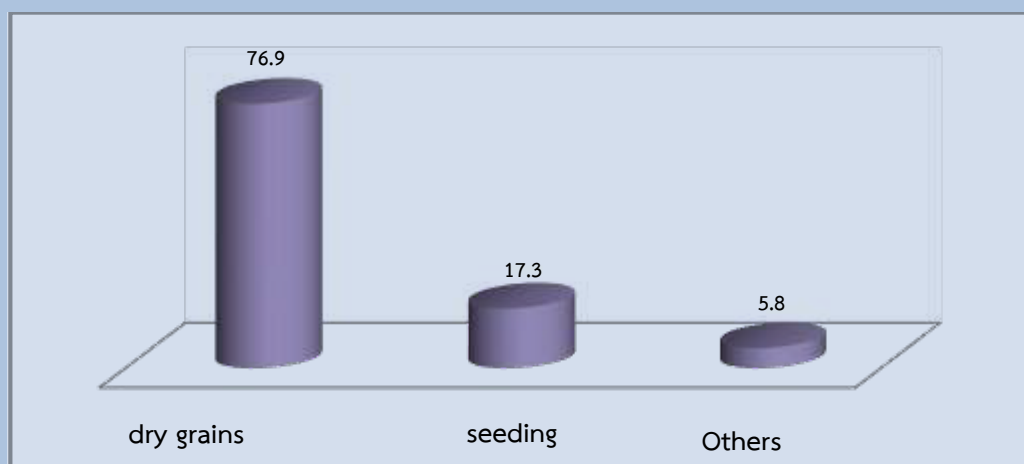
4.3 Grade of Yield and Types of Yield Distribution

1) Grade of yield

According to an interview conducted on farmers who planted soybean for propagation purpose in Chiangmai regarding grade of soybean yield, it is found that all farmers sold soybean in mixed- grade form. Buyers would classify soybean yield afterwards.

2) Types of Yield Distribution

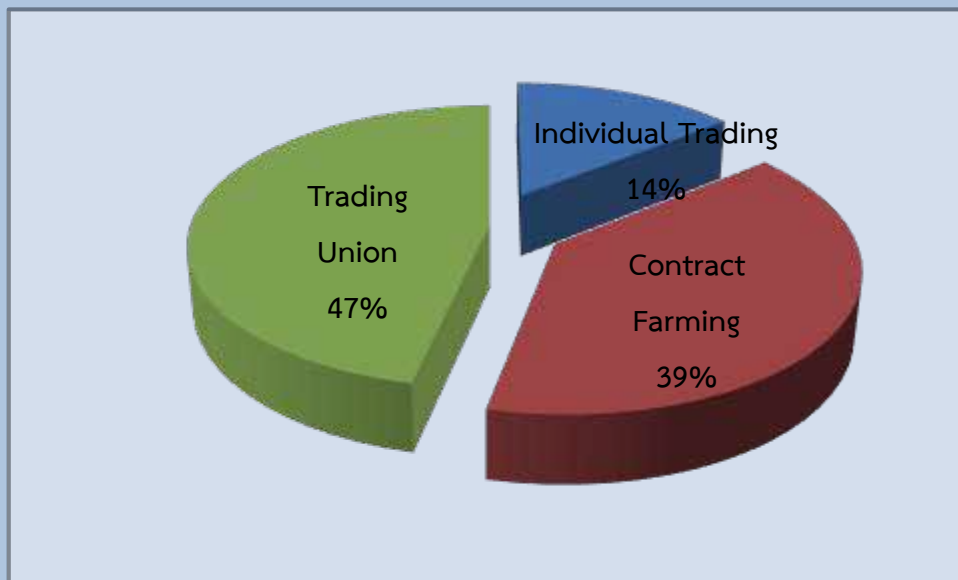
With regard to ways of distribution of yield produced by farmers, it is found that 76.9% of soybean yield that farmers were able to produce would be sold in form of dry grains. While 17.3% would be stored for seeding and 5.8% was used for other purposes such as fermented soybean, self-consumption, etc. Most farmers would sell their yield by way of selling union, contract farming and individual sale respectively.



Picture 4.6 Percentage of Types of Yield Distribution

3) Trading Union

Most farmers would sell their yield by way of selling union which is 47%, contract farming for 39% and individual sale for 14%.

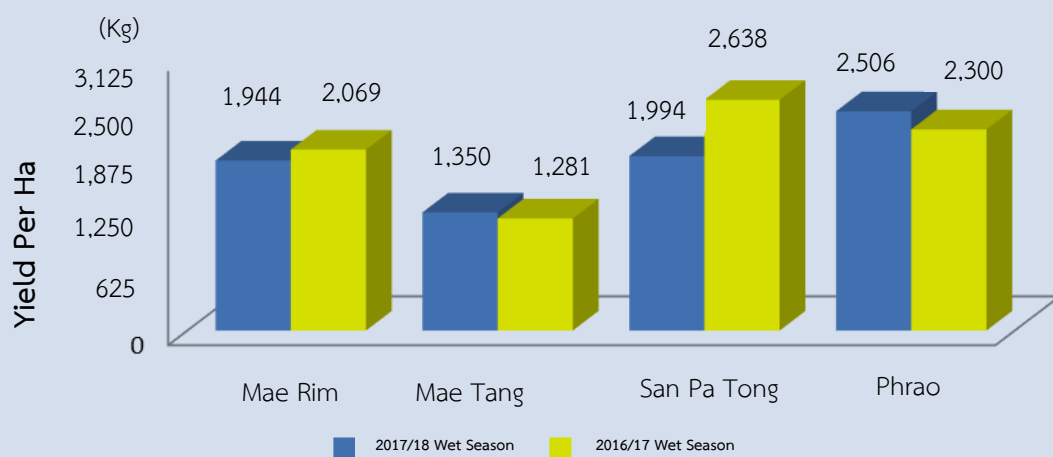


Picture 4.7 Percentage of Trading Union

4.4 Soybean Yield Situation

1) Tendency and Direction of Soybean Wet Season's Yield per Ha

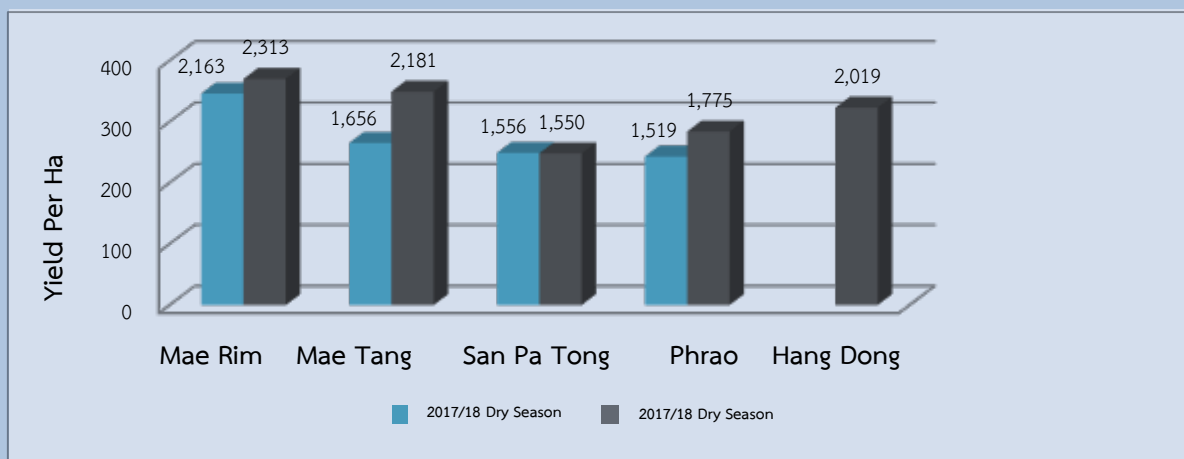
According to a survey on tendency and direction of soybean Wet Season's yield per ha, comparing planting year 2017/18 and 2016/17 shown in amphoe, it is found that an average yield in amphoe Mae Rim and San Pa Tong tends to increase due to adequacy of water and well caring by farmers. While in amphoe Mae Tang and Phrao, yeild per ha tends to decrease to due excess rain causing damage to soybean. There were no farmers planting soybean Wet Season in amphoe Hang Dong.



Picture 4.8 Comparison of Soybean Yield Per Hectare: Wet Season in 2017/18 and 2016/17

2) Tendency and Direction of Soybean Dry Season's Yield per Ha

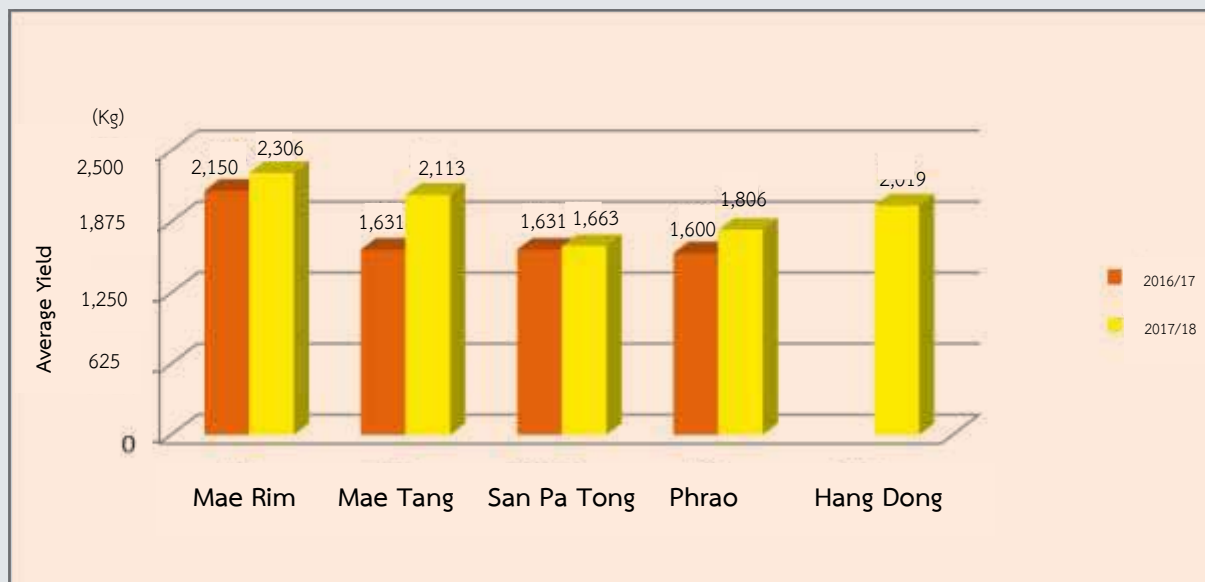
According to a survey on yield of soybean Dry Season, comparing planting year 2017/18 and 2016/17 shown in amphoe, it is found that an average yield per hai in 5 amphoe tends to increase due to adequacy of water and well caring by farmers.



Picture 4.9 Comparison of Soybean Yield Per Hectare: Dry Season in 2017/18 and 2016/17

3) Tendency and Direction of Both Seasons of Soybean Yield per Ha

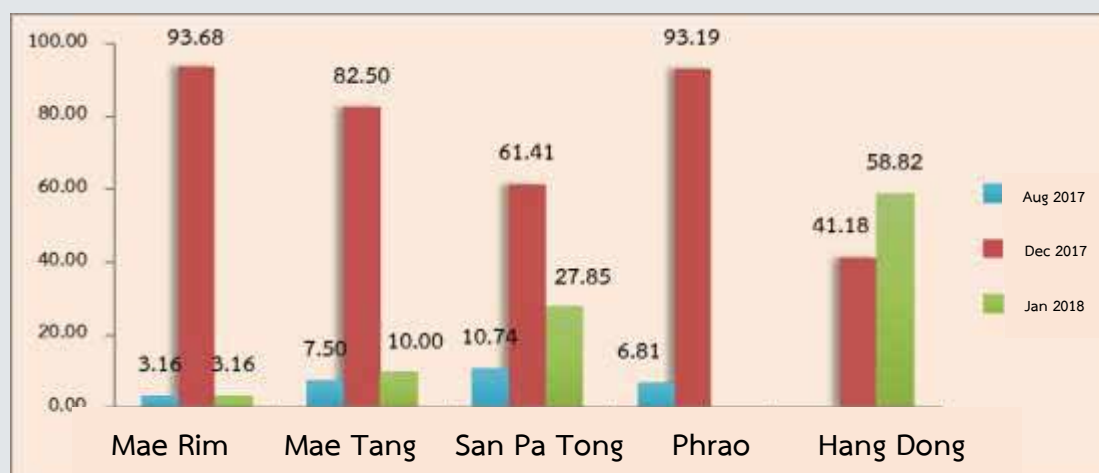
According to a survey on yield of both seasons of soybean, comparing planting year 2017/18 and 2016/17 shown in amphoe, it is found that an average yield per ha in 5 amphoe tends to increase due to adequacy of water and well caring by farmers.



Picture 4.10 Comparison of Soybean Yield Per Hectare: Wet and Dry Seasons in 2017/18 and 2016/17

4) Percentage of Planting Shown in Months and Amphoe

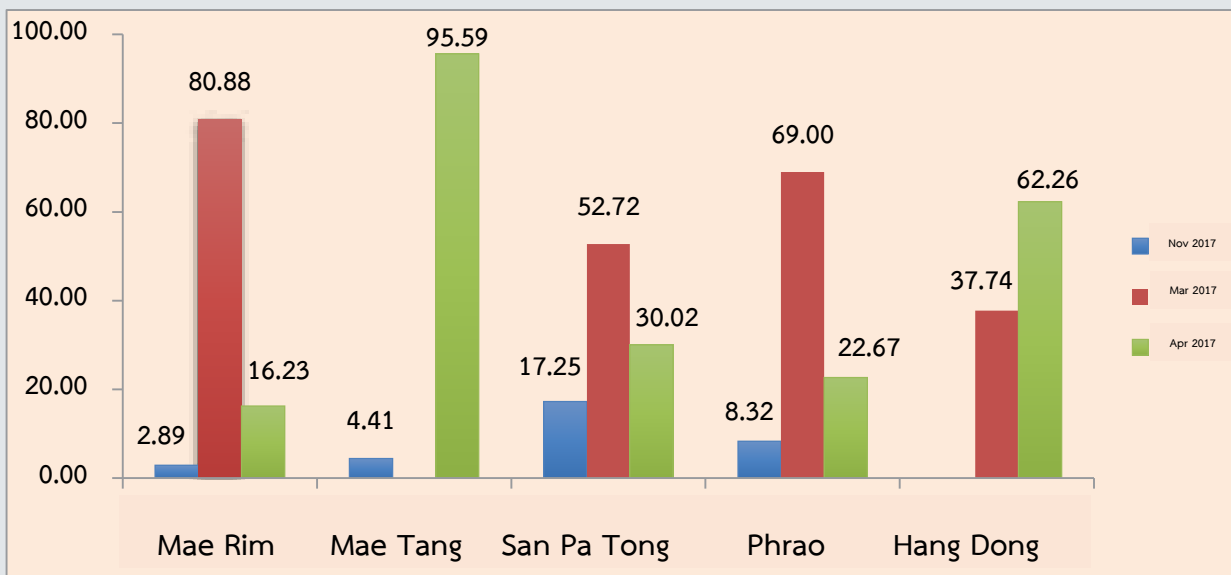
According to a survey regarding percentage of planting by months, it is found that Soybean Wet Season was mostly planted in August, while Soybean Dry Season was mostly planted in December and January.



Picture 4.11 Percentage of Planting Shown in Months and Amphoe

5) Percentage of Yield Shown in Amphoe

According to a survey regarding an average yield in months, it is found that Soybean Wet Season was harvested in November, while Soybean Dry Season is mostly harvested from March to April.



Picture 4.12 Percentage of Yield Shown in Months and Amphoe



4.5 Cost of Production Analysis

Cost of production analysis will be conducted by considering both cash and non cash cost literally used by farmers. Cash cost is a cost literally paid by farmers in cash and as wage of labor. Non cash cost is not a cost literally paid in cash but is assessed as production factors owned by farmers such as household labor, seeding cost, etc. Cost of production can be divided into 2 categories which are variable cost and fixed cost.

Variable cost is divided into 3 parts. The first one is labor cost namely; soil preparation cost, planting cost, caring cost and harvesting cost. The second one is materials cost namely; seeding cost, fertilizer cost, insecticide and weed prevention cost, other substance and soil enhancing cost, fuels and lubricant cost, agricultural and used-up materials cost and agricultural equipment repairing cost.

Fixed cost is divided into agricultural equipment depreciation cost, agricultural equipment opportunity cost. Land rental fee is calculated for an entire planting season both in cash and non cash. In case of land owned by a sample farmer, it shall be calculated as per land rental rate applied in such place.

According to a study on cost of production of Soybean Wet Season, it is found that the average cost of production per ha of Soybean Wet Season is equal to USD 955.80 which can be divided into cash cost of USD 447.54, that is 46.82% of the total cost and non cash cost of USD 508.26, that is 53.18% of the total cost. With regard to variable and fixed cost, it is found that there is a variable cost of USD 828.62 per ha that is 86.69% of the total cost. One major sort of variable cost is labor wage and machinery using cost incurred from planting preparation until harvesting which is the total of USD 414.87 per ha, that is 43.41% of the total cost. The other major sort of variable cost is materials cost which is the total of USD 394.86 per ha, that is 41.31% of the total cost. With regard to fixed cost which consists of land rental fee, agricultural equipment depreciation cost and agricultural equipment opportunity cost, it is found that there is a fixed cost of USD 127.18 per ha that is 13.31% of the total cost (Table 4.1)

According to a study on cost of production of Soybean Dry season, it is found that the average cost of production per ha of Soybean Dry season is equal to USD 866.96 which can be divided into cash cost of USD 513.56, that is 59.24% of the total cost and non cash cost of USD 353.40, that is 40.76% of the total cost. With regard to variable and fixed cost, it is found that there is a variable cost of USD 701.87 per ha that is 80.96% of the total cost. One major sort of variable cost is labor wage and machinery using cost incurred from planting preparation until harvesting which is the total of USD 467.49 per ha, that is 53.92% of the total cost. The other major sort of variable cost is materials cost which is the total of USD 218.38 per ha, that is 25.19% of the total cost. With regard to fixed cost which consists of land rental fee, agricultural equipment depreciation cost and agricultural equipment opportunity cost, it is found that there is a fixed cost of USD 165.09 per ha that is 19.04% of the total cost (Table 4.2)

According to a study on cost of production of both seasons of soybean, it is found that the average cost of production per rai of both generations of soybean is equal to USD 902.32 which can be divided into cash cost of USD 487.29, that is 54.00% of the total cost and non cash cost of USD 415.03, that is 46.00% of the total cost. With regard to variable and fixed cost, it is found that there is a variable cost of USD 752.31 per ha that is 83.38% of the total cost. One major sort of variable cost is labor wage and machinery using cost incurred from planting preparation until harvesting which is the total of USD 446.55 per ha, that is 49.49% of the total cost. The other major sort of variable cost is materials cost which is the total of USD 288.61 per ha, that is 31.99% of the total cost. With regard to fixed cost which consists of land rental fee, agricultural equipment depreciation cost and agricultural equipment opportunity cost, it is found that there is a fixed cost of USD 150.00 per ha that is 16.62% of the total cost (Table 4.3)

4.6 Return Analysis

With regard to return of Soybean Wet Season, it is found that farmers are able to produce at an average amount of 1,735.56 kg. and sell their yield at an average price of USD 0.41 per kg., making an average income of USD 716.19 per ha. After cost deduction, it left those farmers suffer a net average loss of USD 239.61 per ha or USD 0.14 per kg.

With regard to return of Soybean Dry Season, it is found that farmers are able to produce at an average amount of 1,974.75 kg. and sell their yield at an average price of USD 0.47 per kg., making an average income of USD 932.85 per ha. After cost deduction, it left those farmers suffer a net average profit of USD 65.89 per ha or USD per 0.03 kg

With regard to return of both seasons of soybean, it is found that farmers are able to produce at an average amount of 1,879.56 kg. and sell their yield at an average price of USD 0.44 per kg., making an average income of USD 836.05 per ha. After cost deduction, it left those farmers suffer a net average loss of USD 66.27 per ha or THB 0.04 per kg.

Table 4.1 Soybean Cost of Production: Wet Season, Planting Year 2017/18

Unit: USD/ha

Items	Average of Wet Season			Percentage
	Cash	Assessed	Total	
1. Variable Cost	421.05	407.57	828.62	86.69
1.1 Labor Cost	175.22	239.65	414.87	43.41
Soil Preparation	38.25	14.17	52.41	5.48
Planting	26.91	5.20	32.11	3.36
Caring	0.00	147.58	147.58	15.44
Harvesting	110.05	72.71	182.77	19.12
1.2 Materials Cost	236.23	158.63	394.86	41.31
Seeding Cost	72.25	158.63	230.87	24.15
Fertilizer Cost	87.64	0.00	87.64	9.17
Insecticide and Weed Prevention Cost	45.90	0.00	45.90	4.80
Other Substance and Soil Enhancing Cost	8.08	0.00	8.08	0.85
Fuels and Lubricant Cost	12.10	0.00	12.10	1.27
Agricultural and Used-Up Materials	7.71	0.00	7.71	0.81
Agricultural Equipment Repairing Cost	2.57	0.00	2.57	0.27
1.3 Investment Opportunity Cost	9.60	9.29	18.89	1.98
2. Fixed Cost	26.49	100.69	127.18	13.31
2.1 Land Rental Fee	26.49	47.10	73.59	7.70
2.2 Agricultural Equipment Depreciation Cost	0.00	49.74	49.74	5.20
2.3 Agricultural Equipment Opportunity Cost	0.00	3.85	3.85	0.40
3. Total Cost Per Ha	447.54	508.26	995.80	100.00
4. Total Cost Per Kg.			0.55	
5. Yield Per Ha (kg.)			1,735.56	
6. Price at Planting Field (USD/kg.)			0.41	
7. Return Per Ha			716.19	
8. Net Return Per Ha			-239.61	
9. Net Return Per Kg.			-0.14	

Table 4.2 Soybean Cost of Production: Dry Season, Planting Year 2017/18

Unit: USD/ha

Items	Average of Dry Season			Percentage
	Cash	Assessed	Total	
1. Variable Cost	468.12	233.75	701.87	80.96
1.1 Labor Cost	293.93	173.56	467.49	53.92
Soil Preparation	24.21	48.57	72.78	8.39
Planting	56.02	27.80	83.81	9.67
Caring	15.94	90.26	106.20	12.25
Harvesting	197.76	6.93	204.69	23.61
1.2 Materials Cost	163.15	55.23	218.38	25.19
Seeding Cost	51.37	21.37	72.74	8.39
Fertilizer Cost	46.66	28.87	75.52	8.71
Insecticide and Weed Prevention Cost	33.32	0.00	33.32	3.84
Other Substance and Soil Enhancing Cost	7.58	4.84	12.42	1.43
Fuels and Lubricant Cost	5.45	0.00	5.45	0.63
Agricultural and Used-Up Materials	17.54	0.05	17.59	2.03
Agricultural Equipment Repairing Cost	1.24	0.11	1.34	0.15
1.3 Investment Opportunity Cost	11.04	4.96	16.00	1.85
2. Fixed Cost	45.44	119.65	65.09	19.04
2.1 Land Rental Fee	45.44	80.79	126.23	14.56
2.2 Agricultural Equipment Depreciation Cost	0.00	36.38	36.38	4.20
2.3 Agricultural Equipment Opportunity Cost	0.00	2.49	2.49	0.29
3. Total Cost Per Ha	513.56	353.40	866.96	100.00
4. Total Cost Per Kg.			0.44	
5. Yield Per Ha (kg.)			1,974.75	
6. Price at Planting Field (USD/kg.)			0.47	
7. Return Per Ha			932.85	
8. Net Return Per Ha			65.89	
9. Net Return Per Kg.			0.03	

Table 4.3 Soybean Cost of Production: Both Season, Planting Year 2017/18

Unit: USD/ha

Items	Average of Both Seasons			Percentage
	Cash	Assessed	Total	
1. Variable Cost	449.39	302.92	752.31	83.38
1.1 Labor Cost	246.69	199.86	446.55	49.49
Soil Preparation	29.79	34.88	64.67	7.17
Planting	44.44	18.80	63.24	7.01
Caring	9.60	113.07	122.67	13.59
Harvesting	162.86	33.11	195.97	21.72
1.2 Materials Cost	192.23	96.38	288.61	31.99
Seeding Cost	59.68	75.99	135.67	15.04
Fertilizer Cost	62.97	17.38	80.35	8.90
Insecticide and Weed Prevention Cost	38.33	0.00	38.33	4.25
Other Substance and Soil Enhancing Cost	7.78	2.91	10.69	1.18
Fuels and Lubricant Cost	8.10	0.000.00	8.10	0.90
Agricultural and Used-Up Materials	13.63	0.03	13.66	1.51
Agricultural Equipment Repairing Cost	1.77	0.06	1.83	0.20
1.3 Investment Opportunity Cost	10.47	6.69	17.16	1.90
2. Fixed Cost	37.90	112.10	150.00	16.62
2.1 Land Rental Fee	37.90	67.38	105.28	11.67
2.2 Agricultural Equipment Depreciation Cost	0.00	41.69	41.69	4.62
2.3 Agricultural Equipment Opportunity Cost	0.00	3.03	3.03	0.34
3. Total Cost Per Ha	487.29	415.03	902.32	100.00
4. Total Cost Per Kg.			0.48	
5. Yield Per Ha (kg.)			1,879.56	
6. Price at Planting Field (USD/kg.)			0.44	
7. Return Per Ha			836.05	
8. Net Return Per Ha			-66.27	
9. Net Return Per Kg.			-0.04	

4.7 Marketing Direction of Soybean

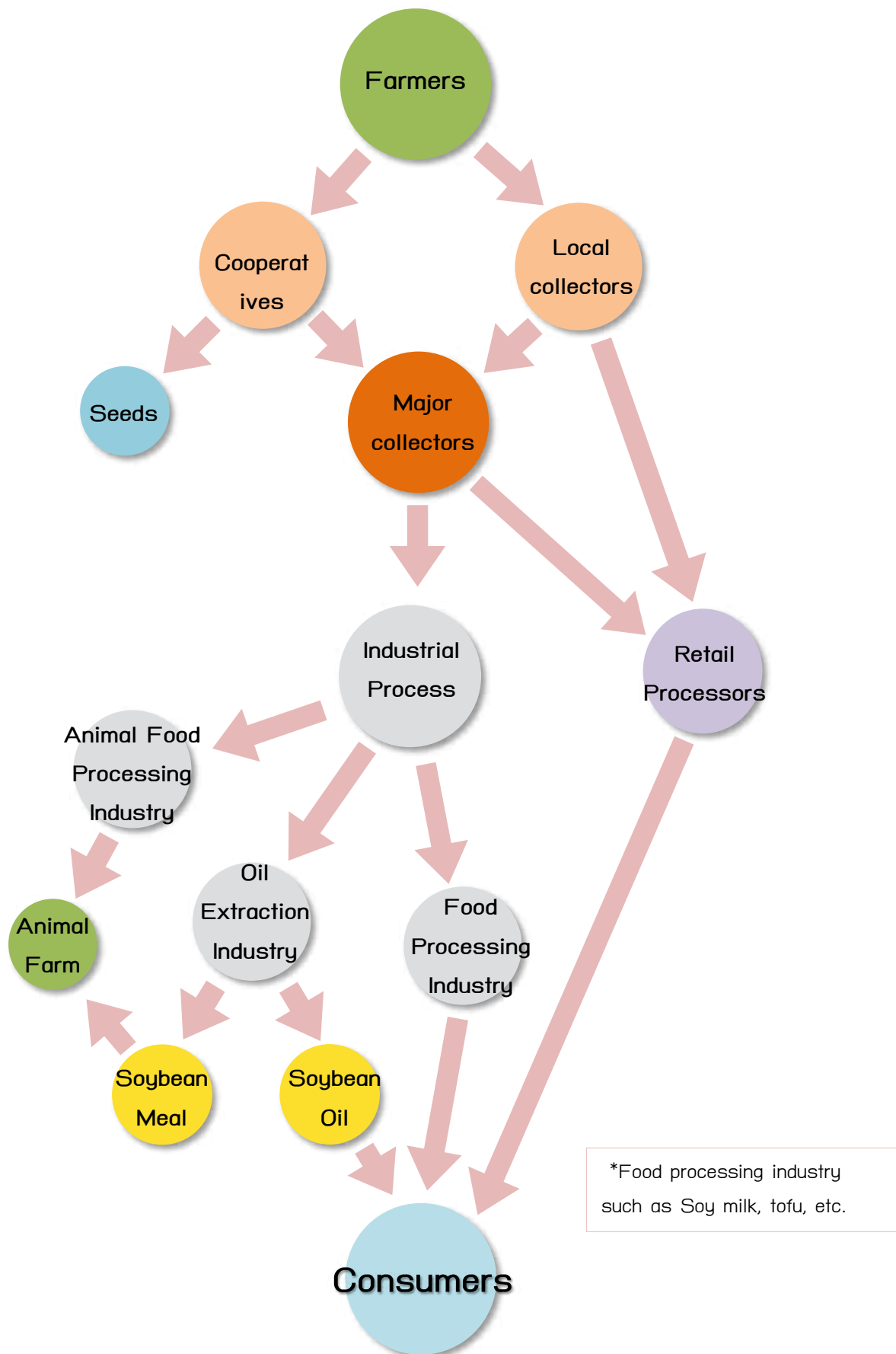
The Plant Seeds Research and Development Center has developed the best selected seed variety to be the major seed variety and deliver those seed variety to registered farmers to propagate them and sell those seed variety to cooperatives and soybean planters to further plant them for sale. Farmers brought those seeds to plant for consumption or seeding.

Farmers gathered in form of union to sell their mixed-class yield to small accumulators i.e. cooperatives, middlemen, etc. The small accumulators will classify the yield based on their sizes and quality to fit buyers' need, then, trade them to major accumulators or local processors who will sell the products to consumers in various forms such as fermented soybean, soy milk and pigeon peas, etc.

The major accumulators will enhance soybean quality by drying in order to reduce humidity and sift to separate contaminants such as rotten grains, stones and small branches, etc. After that soybean grains will be classified into consumption grade, animal feed grade and oil extraction grade. Soybean grains in consumption grade will be sold to food processing industry such as soy milk, tofu and soy sauce, etc. or partly to local processors who sell such grains to major wholesale community like Yaowarat. Soybean grains in animal feed grade will be chopped and steamed prior to entering animal feed processing industry. Soybean grains in oil extraction grade will be used in soybean oil industry to extract oil for sale to consumers and there will be an important by-product of soybean residue to be used in animal feed production (Picture 4.13).



Picture 4.13 Marketing Direction of Soybean Daigram



Chapter 5 Conclusion and Recommendations

5.1 Conclusion

According to a study on process of soybean production in Chiang Mai, it is found that most farmers chose planting by way of drill planting, most planting was done inside irrigation zone and almost all of the farmers chose to plant Chiang Mai 60 at an average weight of seeds of 112.5 kg. per ha. Most farmers used chemical fertilizer at an average of 168.75 kg. per ha. Way of distribution were done mostly by selling dry grains and the rest would be stored for seeding and other purposes such as processing for household consumption.

With regard to the average yield per rai of Soybean Wet Season, year 2017/18, it is found that yield from amphoe Mae Rim and San Pa Tong tends to increase, while yield in amphoe Mae Tang and Phrao tends to decrease. In addition, yield per ha of Soybean Dry Season, year 2017/18 from every ampho tend to increase.

With regard to planting and and harvesting sorted by months, it is found that farmers were likely to plant Soybean Wet Season in August and harvest in November. While Soybean Dry Season was likely to be planted during December and January and harvested during March and April.

In using soil enhancing substance which is rhizobium, it is found that most farmers were aware that rhizobium was able to enhance soybean yield so they used rhizobium in the production.

In terms of marketing, it is found that most farmers sold their yield to agricultural cooperatives and accumulators in their provinces respectively. Farmers also gather in form of union to sell their yield in mixed-grade form without classifying their yield by its quality.

With regard to a study on cost of production of Soybean Wet Season, it is found that the cost of soybean production per ha is equal to USD 955.80 which consists of an average of variable cost of USD 828.62 per ha and an average of fixed cost of USD 127.18 per ha, altogether being an average cost of USD 0.55 per kg. In terms of the return, it is found that farmers were able to produce at an average amount of 1,735.56 kg. per ha and sell at an average price of USD 0.41 per kg., being the total return of USD 716.19 per ha and making them suffer an average loss of USD 239.61 per ha or USD 0.14 per kg.

With regard to a study on cost of production of Soybean Dry Season, it is found that the cost of soybean production per rai is equal to USD 866.96 which consists of an average of variable cost of USD 701.87 per ha and an average of fixed cost of USD 165.09 per ha, altogether being an average cost of USD 0.44 per kg. In terms of the return, it is found that farmers were able to produce at an average amount of 1,974.75 kg. per ha and sell at an average price of USD 0.47 per kg., being the total return of USD 932.85 per ha and making an average profit of USD 65.89 per ha or USD 0.03 per kg.

With regard to a study on cost of production of both seasons of soybean, it is found that the cost of soybean production per ha is equal to USD 902.32 which consists of an average of variable cost of USD 752.31 per ha and an average of fixed cost of USD 150.00 per ha, altogether being an average cost of USD 0.48 per kg. In terms of the return, it is found that farmers were able to produce at an average amount of 1,879.56 kg. per ha and sell at an average price of USD 0.44 per kg., being the total return of USD 836.05 per ha and making them suffer an average loss of USD 66.27 per ha or USD 0.04 per kg.

This study finds that soybean farmers in Chiang Mai are confronting high level of cost of production. Also, they sold their yield by way of mixed-grade soybean without classifying the products leading to low price purchase. Thus, some farmers turn to other plants that give them more return than that of soybean e.g. second rice, sweet corn, etc. This leads to the decrease of soybean yield.

The study of soybean supply chain, planting year 2017/18 aims to analyze cost, return, yield per ha and other details by interviewing soybean farmers in Chiang Mai for 85 samplings and by using purposive method on merchants and entrepreneur namely agricultural cooperatives in Chiang Mai and major accumulators in Sa Kaeo in total of 7 samplings.

5.2 Recommendations

1) The government sector should adopt a policy on sustainably soybean production promotion and development and promote the reduction of cost of production e.g. promoting good variety, use of machinery in substitution for labor, know-how building on soybean production, which will enhance production efficiency as well as soybean yield.

2) Promoting the production of good quality seed variety for adequate domestic use and exporting to neighboring countries since, at present, there is still a demand in seed variety in neighboring countries' markets.

3) Promoting the production of soybean's quality that fits buyers' demand for price maximization since an amount of yield produced in Thailand is still lower than the amount imported. Only 5% of the total demand is produced in the country.

4) Promoting the use of soybean by-products e.g. using soybean shell as a result of soybean milling as mushroom propagation materials which can be sold at USD 3.54-4.42 per kg. to generate another source of income for farmers.

Bibliography

- National Bureau of Agricultural Commodity and Food Standards. 2004. **Good Agricultural Practices on Soybean**. Bangkok: Ministry of Agriculture and Cooperatives
- Office of Agricultural Economics. 2017. **Basic Information on Agricultural Economics in 2017**. Bangkok: Center for Agricultural Information, Ministry of Agriculture and Cooperatives
- Office of Agricultural Economics. 2016. **Office of Agricultural Economics' Handbook on Research and Assessment Papers Drafting**. Bangkok: Center for Agricultural Information, Ministry of Agriculture and Cooperatives
- Office of Agricultural Economics. 2018. **Soybean: Expected Yield at 15% Humidity Rate (Planting Year 2018/19) [online]**. Available from: [:http://www.oae.go.th/download/forecastdata/region/soybean.pdf](http://www.oae.go.th/download/forecastdata/region/soybean.pdf) (Access on: March 29, 2018).
- Associate Professor Dr. Theera Aeksamatrameth. 2011. **Soybean : Glycine max [online]**. from: <http://www.natres.psu.ac.th/departement/plantscience/510211/pages/soybean.htm> (Access on: March 29, 2018).



APPENDICES





The background of the entire page is a close-up photograph of yellow soybeans. Some beans are whole, while others are split, showing their internal structure. A single soybean pod, still attached to its fibrous husk, is visible on the left side of the page.

Appendix 1

Soybean Production Questionnaire



Name of Survey Officer <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; width: 40px; height: 20px; margin: 2px;"></div> <div style="border: 1px solid black; width: 40px; height: 20px; margin: 2px;"></div> </div> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; width: 40px; height: 20px; margin: 2px;"></div> <div style="border: 1px solid black; width: 40px; height: 20px; margin: 2px;"></div> </div>		For Editorial Officer <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; width: 40px; height: 20px; margin: 2px;"></div> <div style="border: 1px solid black; width: 40px; height: 20px; margin: 2px;"></div> </div> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; width: 40px; height: 20px; margin: 2px;"></div> <div style="border: 1px solid black; width: 40px; height: 20px; margin: 2px;"></div> </div>																																	
OAE No. <div style="border: 1px solid black; width: 40px; height: 20px; display: inline-block;"></div> Code <div style="border: 1px solid black; width: 40px; height: 20px; display: inline-block;"></div> Date Month Year		Field Crop Questionnaire Crop in 2017/18 <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: 100px; text-align: center;"> Soybean Wet Season in 2017/18 </div> The shared information will remain confidential and only public information will be disseminated in statistical estimation																																	
Name of Holder Identification Number Sample Number House Number Village Number Village's Name Sub-district District Province Telephone Number Name of Interviewee which is of the holder Telephone Coordinate E = N =		For Editorial Officer <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>Province</th> <th>District</th> <th>Sub-district</th> <th>Village No.</th> <th>Group No.</th> <th>Holder Sample No.</th> <th>Sur.O. Code</th> <th>Ed.O. Code</th> </tr> <tr> <td>01</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>17</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>		Province	District	Sub-district	Village No.	Group No.	Holder Sample No.	Sur.O. Code	Ed.O. Code	01							17																
Province	District	Sub-district	Village No.	Group No.	Holder Sample No.	Sur.O. Code	Ed.O. Code																												
01							17																												
No. 1		No. 2																																	
19		20 21																																	
Planting Area (Hectare) (1) (2) (3)		Harvesting Area (Hectare) (4) (5)																																	
Yield Quantity (kg.) % moisture		Yield of soybean must be removed from hulls																																	
120120		120120																																	
Ask farmers on planting area, harvesting area and soybean yield wet season in 2016/17 (last year) All lands must be combined and yield must be farmer's own production within the sample village area only.		Ask farmers about the sales volume of soybean wet season from 1 July 2016 to 30 January 2017 Yield must be farmer's own production within the sample village area only.																																	
Monthly sales volume (kg.)		Monthly sales volume (kg.)																																	
2016		2017																																	
Total sales volume (kg.) (1) (2)		Total sales volume (kg.) (1) (2)																																	
120120		120120																																	

19 No. of card <div style="border: 1px solid black; padding: 2px; display: inline-block;"> No. 3 </div> <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 10px;"> 20 21 </div>		Ask the following questionnaires below to farmers about the details of their holding on soybean Wet Season in 2017/18 (planted this year) Information provided must be within the sample village area only.				19 No. of card <div style="border: 1px solid black; padding: 2px; display: inline-block;"> No. 4 </div> <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 10px;"> 20 21 </div>		Ask for causes of an increase and decrease of planting area and yield per hectare that occurred/ expecting to occur in 2017/18																															
Land Parcel (1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12) (13)	Crop No. 120120 120120 120120 120120 120120	Varieties No. 	Name of Varieties 	Planting methods 	Planted inside/ outside irrigation area 	Harvesting			Harvested/Expecting			Planting			Planting/Expecting			Cause of area planted (increase/decrease) from the previous year																					
						Yield/expecting		Area (Hectare)		Quantity (kg.)		% moisture		Increase		Decrease		no change		Specify																			
						Quantity (kg.)		Area (Hectare)		Quantity (kg.)		% moisture		Increase		Decrease		no change		Specify																			
						Quantity (kg.)		Area (Hectare)		Quantity (kg.)		% moisture		Increase		Decrease		no change		Specify																			
						Quantity (kg.)		Area (Hectare)		Quantity (kg.)		% moisture		Increase		Decrease		no change		Specify																			
Who do you sell your products to?										Who do you sell your products to?																													
Fertilizer Application					Distribution					Who do you sell your products to?																													
Fertilizer (Used + Expect to apply)					Other (Specify)					Grade Specify....					Mixed grade					Distance					Transportation cost														
Chemical Fertilizer					Organic manure(Dry)					Keep for seeding					Sell Processed					Sell Dry					Sell Seed					Quantity (kg.)					Price (USD)				
Fertilizer (hectare)					Quantity (kg.)					Fertilizer Area (hectare)					Quantity (kg.)					Price (USD)					Price (USD)					Price (USD)									
(14) (15) (16) (17)					 					 					 					 					 					 									
Remarks: e.g. oil grade, export grande										Remarks: e.g. oil grade, export grande										Remarks: e.g. oil grade, export grande																			
Memo other situations, opinions and suggestions										Memo other situations, opinions and suggestions										Memo other situations, opinions and suggestions																			

Cause no. increases/decreases

- Price in the previous year = 1
- Weather = 2
- Planted as replacement/ plant other crop replacement (specify crop name)... = 3
- Other (specify)... = 4

Cause no. increases/decreases

- maintenance = 1
- water quantity = 2
- Varieties = 3
- Natural diseases = 4
- Diseases, insect, rodents epidemic = 5
- Other (specify) = 6

Varieties Code

- local variety = 01
- official variety (SJ.1-5, Sukhothai1, Nakhonsawan 1 (Except MKh.35, ChM.60) = 02
- MKh. 35 = 03
- ChM. 60 = 04

inside/outside irrigation code

- Main irrigation = 01
- Support irrigation = 02
- Public irrigation = 03
- Outside irrigation area = 04

Planted/Harvest Month

- Jan=1, Feb=2,...,Dec=12
- Drop, Sprinkle = 01
- Sow = 02

Planting method Code

- Drop, Sprinkle = 01
- Sow = 02

Name of Survey Officer <div style="display: flex; justify-content: space-around; align-items: center;"> <div>.....</div> <div style="border: 1px solid black; width: 30px; height: 20px; display: flex; align-items: center; justify-content: center;">Code</div> </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> Date Month Year </div>		For Editorial Officer <div style="display: flex; justify-content: space-around; align-items: center;"> <div>.....</div> <div style="border: 1px solid black; width: 30px; height: 20px; display: flex; align-items: center; justify-content: center;">Code</div> </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> Date Month Year </div>																																	
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Province	District	Sub-district	Village No.	Group No.	Holder Sample No.	Sur.O. Code	Ed.O. Code																												
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<div style="display: flex; justify-content: space-between;"> <div>19</div> <div>20</div> <div>21</div> </div> <div style="border: 1px solid black; padding: 5px; display: inline-block;"> No. 1 </div> <div style="display: flex; justify-content: space-between;"> <div>.....</div> <div>Number of Card</div> <div>.....</div> </div>		Ask farmers on planting area, harvesting area and soybean yield wet season in 2016/17 (last year) All lands must be combined and yield must be farmer's own production within the sample village area only.																																	
Crop No.	Planting Area (Hectare)	Harvesting Area (Hectare)	Yield																																
(1)	(2)	(3)	Quantity (kg.) % moisture																																
120120			(4) (5)																																
<div style="display: flex; justify-content: space-between;"> <div>19</div> <div>20</div> <div>21</div> </div> <div style="border: 1px solid black; padding: 5px; display: inline-block;"> No. 2 </div> <div style="display: flex; justify-content: space-between;"> <div>.....</div> <div>Number of Card</div> <div>.....</div> </div>		Ask farmers about the sales volume of soybean wet season from 1 July 2016 to 30 January 2017 Yield must be farmer's own production within the sample village area only.																																	
<div style="display: flex; justify-content: space-between;"> <div>19</div> <div>20</div> <div>21</div> </div> <div style="border: 1px solid black; padding: 5px; display: inline-block;"> No. 2 </div> <div style="display: flex; justify-content: space-between;"> <div>.....</div> <div>Number of Card</div> <div>.....</div> </div>		Monthly sales volume (kg.)																																	
Total sales volume (kg.)		2016																																	
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(2)		(8)	(9)																																
120120		Feb	Mar																																
(2)		(10)	(11)																																
120120		Apr	May																																
(2)		(12)	(13)																																
120120		Jun	Jun																																
(2)		(14)	(14)																																

19 No. of card <div style="border: 1px solid black; padding: 2px; display: inline-block;"> No. 3 </div>		Ask the following questionnaires below to farmers about the details of their holding on soybean Wet Season in 2017/18 (planted this year) Information provided must be within the sample village area only.				19 No. of card <div style="border: 1px solid black; padding: 2px; display: inline-block;"> No. 4 </div>		Ask for causes of an increase and decrease of planting area and yield per hectare that occurred/ expecting to occur in 2017/18													
Land Parcel No.		Crop Varieties No.		Name of Variates		Planting methods		Planted inside/outside irrigation area		Harvesting				Cause of area planted (increase/decrease) from the previous year							
										Cause of area planted (increase/decrease) from the previous year											
(1) (2)		(3) (4)		(5) (6)		Planted/Expecting Planted month/ expecting (7)		Area (Hectare) (8)		Type of Seed (Kg.) (9)		Harvesting month/ expecting (10)		Area (Hectare) (11)		Yield/expecting Quantity (kg.) (12)		% moisture (13)		Increase 1 Decrease 2 no change 3	
																				Increase 1 Decrease 2 no change 3	
120120																		Cause no. increases/decreases - Price in the previous year = 1 - Weather = 2 - Planted as replacement/ plant other crop replacement (specify crop name)... = 3 - Other (Specify)... = 4			
120120																		Cause no. increases/decreases - maintenance = 1 - water quantity = 2 - Varieties = 3			
120120																		Cause no. increases/decreases - Natural diseasester = 4 - Diseases, insect, rodents epidemic = 5 - Other (specify) = 6			
120120																		Cause no. increases/decreases - Diseases, insect, rodents epidemic = 5 - Other (specify) = 6			
120120																		Cause no. increases/decreases - Diseases, insect, rodents epidemic = 5 - Other (specify) = 6			
																		Cause no. increases/decreases - Diseases, insect, rodents epidemic = 5 - Other (specify) = 6			

Who do you sell your products to?										
Fertilizer Application					Distribution					
Fertilizer (Used + Expect to apply)		Sell Dry Seed			Keep for seeding		Other (Specify)		Type of clients	
Chemical Fertilizer	Organic manure(Dry)	Quantity (kg.)	Fertilizer Area (hectare)	Quantity (kg.)	(14)	(15)	(16)	(17)	Local traders	Regional traders
									Agricultural group	Agricultural cooperatives
									Factories.....	Others.....
									Remarks: e.g. oil grade, export grande	
Memo other situations, opinions and suggestions										

Varieties Code	
local variety = 01 official variety (Sl.1-5, Sukhothai1, Nakhonsawan 1 (Except MKh.35, ChM.60) = 02 - MKh. 35 = 03 - ChM. 60 = 04	inside/outside irrigation code - Main irrigation= 01 - Support irrigation =02 - Public irrigation = 03 - Outside irrigation area= 04



Appendix 2

Soybean Production Survey Handbook



Appendix 2 Soybean Production Survey Handbook

Chapter 1

Definitions and codes used in the survey

The surveyors will have to study and understand the definitions and the codes used for recording in the questionnaires correctly and accurately in order to make the collected data correctly respond to the definitions and the codes can be interpreted in a clear and correct manner. Otherwise, the statistical estimates will not accurately follow the academic principles and will not be correspondent with the purpose of the data collection. From this reason, the surveyors and related persons should study and strictly follow the definitions including the defined codes as well as always checking the collected data regularly. In case of finding any problem difficult for making the decision, the director or the Head of the working group should be consulted without delay.

1.1 General definitions and generally used codes

3.1.1 General definitions

(1) **Names of the informants in Listing** refer to the names of the persons who tell the names of the tenants. The surveyors will do the counting such as the sub-district headman / inspector / village headman / assistant / or guru in the village, etc. **by giving the real names - real surnames.**

(2) **Names of the tenants** (names – surnames required to be counted) refer to the names of the heads of the households who manage or are responsible for or maintain the rights of interests derived from the plantation on the plot of land without considering whether the real ownership of such land plot is belong to the tenants who may conduct the operation by themselves or assign the other persons to act on behalf or not but they still benefit in such plot of land.

(3) **Names of the interviewees** refer to the names of the interviewees or the informants to be recorded in the questionnaire on the survey of various kinds of plants. They may be the same persons or another person of the tenants. However, they must be the members of the households who know a lot in such crop planting activities and can answer the questions correctly.

Remarks: -In the case that the names of the interviewees are different from the name of the tenants, identify the relationship or affiliation with such tenants such as being their wives, children, or relatives, etc.

(4) Planted areas refer to the size of land for planting any kind of plants calculated as the area of hectare with the deduction of the area which cannot be planted. It must be an area of 0.01 hectare or more or several areas of 0.02 hectare or over, such as the farm ridges, anthill, trees, ponds, fish ponds, shelters, animal pens, etc., which are when being removed, they will be considered as the total planted area.

In the case that the farmer has planted a particular type of plant and then the damage occurs, even if it is considered the re-planting or not re-planting, the planted area will be the first planted area. However, in case of re-planting and the planting exceeds the previous planted area (the first planted area), the planted area must refer to the first planted combined with the excessive planted area.

In addition, the consideration is required for the planted area with more than 1 time planting in the previous area within the given period to be counted as the total planted area (*as if being separate planted in the different plots*).

(5) Harvested area refers to the harvested area from the planted area of the plants to be harvested in each plot of land calculated as the area of hectare by removing the completely damaged area in such plot of land which must be any area with the size of 0.01 hectare or more or several areas (partly) in combination from 0.02 hectare or over in order to know how many remain. It will be considered as the harvested area.

Therefore, in case of having some damaged parts spread over the plot, if the total is less than 50 square wa, the harvested area will refer to the total planted area. In case of having non-harvested area by leaving it in the field, this area will be deducted.

(6) Completely damaged area refers to the area which is so damaged that it cannot be harvested. Or if it can be harvested, it does not worth the investment or it is expected to gain the yield of not over 10% of the yield gained in normal years by combining the area in some part of over 0.01 hectare or several areas (partly) in combination from 0.02 hectare or over as explained in (5).

(7) Plot of land is the identification of number of plots of land to facilitate the recording of plant data with different features to be studied such as different plant species, planted inside / outside the irrigation areas differently, different planting varieties, different

planting methods by dividing into sub plots and record the data in each plot of land, one line for each plot of land.

(8) Irrigation is the development of water resources by allocating water for multiple uses in various ways such as water storage to supply for the cultivation, drainage, conversion of land, flood relief, hydropower, and water transport.

Irrigation area refers to the area of water resources development by allocating water for agricultural use. Therefore, any agricultural area is interpreted inside or outside the irrigation area for one thing only as follows:

- **Inside the irrigation area** refers to the area used for crop cultivation in the area with irrigation which is classified into 3 types;

1) Main irrigation (Code 01) refers to the area used for crop cultivation in the agricultural service area of the Royal Irrigation Department. It is operated in the form of large and medium irrigation projects including some small projects such as the Royal Irrigation Project particularly in the part of Restructuring and Agricultural Production System Adjustment Project. The main irrigation areas are divided into 2 form as follows:

- **Large irrigation projects** mean multi-purpose irrigation works operated by the Royal Irrigation Department in constructing the dams or reservoirs with the volume of 100 million cubic meters or over or with the surface area of 15 square kilometers or over or with the irrigation area of 12,800 hectare or more.

- **Medium irrigation projects** mean the irrigation projects which are smaller than the large irrigation projects. The water storage source is in the volume of less than 100 million cubic meters or having the water surface area less than 15 square kilometers or having the irrigation area less than 12,800 hectare.

Irrigation system mean the dam with the accessory building, reservoir over the dam, draining dam with the accessory building, water carriage pipe with the accessory building, water ditch with the accessory building, water draining canal with the accessory building which are the constructions built for water storage, water conveying, water drainage, or water control of flood, salted water, and acid water.

- **Irrigation area with irrigation system** means the agricultural area benefiting from the control and management of water with the irrigation system. It consists of an agricultural area with the ditch of water carriage and drainage system including the building for water control.

- **Irrigation area without irrigation system** means the agricultural area using water from the water source of Royal Irrigation Department without building the irrigation system to facilitate and take water to be used in the agricultural areas.

2) Support irrigation (Code 02) means the area used in crop cultivation with the irrigation but located outside the agricultural service area of the Royal Irrigation Department. Most of the areas are in the area of small irrigation projects and are operated by other government agencies which are not the Royal Irrigation Department such as the Water Pumping with Electricity Project, Water Provision to Support the Development Center of Royal Projects, Canal Dredging Project, etc.

3) Public Irrigation (Code 03) means the area where farmers or groups of farmers jointly provide irrigation in the agricultural area for local development that can be developed without the use of government budget.

● **Outside the irrigation zone (Code 4)** refers to the area for crop cultivation located outside the irrigation area.

(9) Planting month refers to the month in which the crops are planted.

◆ **In case of sowing or sprinkling**, the planting month means the month of sowing, dropping or sprinkling.

(10) Harvest month means the month in which the crops are harvested.

(11) The used amount of fertilizer means the amount of fertilizer that the farmer put into the plot of land for cultivation whether it is chemical fertilizers or manure or compost in the unit of kilograms.

Note: - In putting the fertilizer in the same area and same type, identify the fertilizer area once and bring the volume together. However, in case of using different types (chemical fertilizers / organic fertilizers), the area must be recorded of each type and quantity separately.

(12) Yield refers to the crop yield harvested by the farmers. Such yield will include all the yields harvested from such plots of land, i.e., the yield stored for the consumption, cultivation, sale, and the yield used in other ways. However, the left yield in the field or in the trees are excluded.

3.1.2 Generally used codes

Codes of inside / outside the irrigation areas

Main irrigation =	01	Public irrigation =	03
Support irrigation =	02	Outside the irrigation area =	04

Codes of planted/harvested month

January =	01	May =	05	September =	09
February =	02	June =	06	October =	10
March =	03	July =	07	November =	11
April =	04	August =	08	December =	12

3.2 Specific definitions

3.2.1 Soybean wet season cultivated in 2017/18 refers to the soybean which farmers planted from 1st May 2017, to 31th October, 2018 regardless of when the harvesting occurs.

Soybean dry season cultivated in 2017/18 refers to the soybean which farmers planted from 1st November 2017, to 30th April, 2018 regardless of when the harvesting occurs.

(1) **Tenants of soybeans** refer to the farmers who planted soybeans inside the area of sample village and there must be the area for planting of over 0.16 ha regardless where the tenants are located.

(2) **Cultivated varieties** refer to the varieties of soybeans that have been cultivated in each plot of land divided into native varieties of MKh. 35 and ChM. 60.

(3) **Planting method** refers to the nature or process of planting the soybeans into the soil divided into 2 methods:

⊕ **Planting by dropping / sprinkling** means planting the soybeans by dropping or sprinkling the soybean seeds in rows.

⊕ **Planting by sowing** means planting the soybeans by sowing the soybean seeds in the plots which have already prepared for the soil to spread over the whole plot and then reap or reapply again.

(4) **Form of yield** refers to the features of the soybeans crops harvested by the farmer which are in the form of soybeans that have been chopped from the pods. The unit of the yield is in kilogram.

★ Used codes

Plant codes (1 and 2 are in Pole 1, 3 is in Pole 2)

soybeans = 120120

Varieties codes (3 is in Pole 3)

Native varieties = 01 Government varieties = 02

MKh. 35 = 03 ChM. 60 = 04

Chapter2

Questionnaire record

The survey on the plants planted in the year of **2017/18** will be conducted by means of inquiring from the sample households and recording the data into the given questionnaires with the details of inquiry as follows:

Survey Questionnaire on Sample Household

The questionnaire consists of 2 parts:

1. General Information

Other information which is not the data of household production is recorded consisting of:

(1) Names of the Surveyor: Record the name of the surveyor in elaborate handwriting as well as identifying the Office of Agricultural Economics of working, identification code and date / month / year of survey on the top left of the page.

(2) Record the details of the sample tenants, for example, names, surnames, 13-digit ID card No., and the ordinal number of the tenants together with the detailed address of the sample tenants. In case of finding that the interviewee is the different person of the sample tenant as mentioned above, the surveyors must record the names and surnames of the interviewees as well as indicating the relationship to the sample tenants, for example, son, wife, etc., including the telephone number of the sample tenant and the interviewees.

2. Production data

It is the inquiry and the record of plant cultivation data surveyed for the year 2017/18 which contains 4 questions as follows:

Question 1 It is the inquiry on the soybean cultivation data for the year 2016/17 (previous year) which the sample households had already cultivated and harvested without separately questioning each plot or each pen. It must be the soybean cultivation area inside the sample village boundaries only. The details to be inquired and recorded are as follows:

Poles 2- 5: inquiry on the soybean cultivation and harvesting for the year 2016/17 (previous year) as follows:

Pole 2: record the cultivation area (hactare)

Pole 3: record the harvesting area (hactare)

Poles 4-5: record the obtained yield in the unit of kilograms and the humidity

Question 2 It is the inquiry and record of data about the quantity of soybean sale on monthly basis of the sample households. It was the yield obtained in the last year. In this question, soybean wet season and dry season will have different sale duration. From asking in each generation, the results are as below:

Soybeans wet season The total sale volume of the yield from 1st July 2016 to 30th June, 2017, but must be the yield made by the farmers themselves at the farms inside the sample village boundaries only.

The surveyors must inquire and record the data for 14 poles as follows:

Pole 2 The data of total sale volume of the yield of the soybean wet season sold from 1st July, 2016, to 30th June, 2017, only.

Poles 3-14 The data of **the sale volume of the yield** in each month within the period of time as specified above. For example, if the soybeans were sold in August, 2016, the data must be recorded in Pole 4. Or if the soybeans wet season were sold in September, 2016 , the data must be recorded in Pole 5. Or if the soybeans wet season were sold in March, 2017, the data must be recorded in Pole 11, etc.

Note:- The total sale volume of the yield in each month from Poles 3+ 4+ 5+ ...+ 14 must equal to the total sale volume in Pole 2 only.

Soybeans dry season The total sale volume of the yield from **1st January, 2016 to 31st December, 2017** but must be the yield made by the farmers themselves at the farms inside the sample village boundaries only.

The surveyors must inquire and record the data for 14 poles as follows:

Pole 2 The data of total sale volume of the yield of the soybean dry season sold from **1st February, 2017, to 31st January, 2018, only.**

Poles 3-14 The data of the sale volume of the yield in each month within the period of time as specified above. For example, if the soybeans were sold in March, 2017, the data must be recorded in Pole 4. Or if the soybeans dry season were sold in September, 2017, the data must be recorded in Pole 10. Or if the soybeans dry season were sold in November, 2017, the data must be recorded in Pole 12, etc.

Note:- The total sale volume of the yield in each month from Poles 3+4+5+...+14 must equal to the total sale volume in Pole 2 only.

Question 3 It is the inquiry on the data of details about soybean cultivation for the crop year 2017/18 (this year) which are cultivated by the sample tenants inside the sample village boundaries only. The question consists of 4 parts with the relation to all poles as follows:

(1) Classification data (Poles 1-5) It is the inquiry in which the surveyors have to ask and record the data following the items classified in each pole as below:

- Pole1: Ask and record the data for each plot one by one
- Pole 3: Ask and record the data of soybean varieties code
- Pole 4: Ask and record the data of soybean varieties name
- Pole 5: Ask and record the data of soybean varieties planting code
- Pole 6: Ask and record the data of soybean irrigation code

How to complete each data classification in Poles 1-5 should be related so that it is possible to record the data in the same line (plot). If there are one or more differences, the data must be recorded for more than 1 line. For example, the sample households plant the different varieties of soybeans showing that the data must be recorded at least 2 lines following the varieties (Pole 3). However, other data should be considered altogether. How many plots are planted for each variety (Pole 1) must also be split in the line following each plot.

Therefore, it can be seen that each sample household may have more cultivation data. (according to the classified list). In case of diversity, more than one questionnaire is possibly used per household as needed.

The data of cultivated varieties in Pole 3 is specified to be recorded following the defined codes as follows:

- Code 01 means the native varieties.
- Code 02 means the government varieties.
- Code 03 means MKh. 35 varieties.
- Code 04 means ChM. 60 varieties.

(2) Planting data (Poles 7-9) is the data of cultivation in each plot corresponding to the classification data listed above.

- The planted / expected to be planted part must be asked and recorded the data of the planting month code in Pole 7, the size of the plot in Pole 8 in hectare, and the quantity of seeds used in Pole 9.

* In case of planting exceeding the month, the surveyors will have to subdivide it further by adding a line to identify the months to be planted, the size of the space in Pole 8, and the quantity of seeds used in Pole 9 as well.

(3) Harvesting data (Poles 10-13) is the data of harvesting which must be asked and recorded with content continuing from the cultivation data consisting of:

- The harvested / expected to be harvested part must be asked and recorded the data of the harvesting month in Pole 10, the size of the harvesting area in Pole 11 in hectare, and the obtained yield in Poles 12-13 by specifying the % of humidity of the yield as well.

* In case of harvesting exceeding the month, the surveyors will have to subdivide such plot further by adding a line to identify the months to be harvested. Meanwhile, the size of the harvesting area in Pole 11 and the harvested seeds in Poles 12-13 must also be divided following the harvested month.

Note: - For the data of % of humidity in Pole 13, the official must be filled completely. Otherwise, the calculation program cannot be run.

(4) Fertilizer use data (Poles 14-17) is the area of adding fertilizer and the required amount of fertilizer. The content must be continued from the planting data which is divided into 2 parts:

- The chemical fertilizer (Poles 14-15)
- The dry organic fertilizer (Poles 16-17)

For the data recorded in terms of the chemical fertilizer, recording the data of the fertilized areas (or expected to be fertilized), chemical fertilizer in Pole, dry organic fertilizer in Pole 16. The amount of chemical fertilizer used is recorded in Pole 15 and the dry organic fertilizer is recorded in Pole 17 by considering as follows:

1) The area to be fertilized each time should not exceed the size of the plot (in Poles 8 and 10).

2) The volume of fertilizer applied in the same growing area should be recorded in one line and record the amount of fertilizer used every time separate the line for each time or including the amount of fertilizer every time in the same line as the fertilized areas. This depends on the convenience of the inquiry and the records of the surveyors.

Recording the information of the organic fertilizer must be as same as recording the data of chemical fertilizer.

(5) Data of yield distribution (Poles 18-21): It is the data of yield management of the farmers divided into several topics as follows:

- Pole 18: Ask and record the data of sale of dried soybean seeds of the farmer households in the unit of kilogram.

- Pole 19: Ask and record the data of soybean quantity for the process of yield to be sold by the farmer households such as fermented soybean, soybean sheet, soybean chili paste, etc. in the unit of kilogram.

- Pole 20: Ask and record the data of soybean quantity stored for cultivation of the farmer households in the unit of kilogram.

- Pole 21: Ask and record the data of soybean quantity divided for other activities apart from Poles 18-20 of the farmer households in the unit of kilogram.

(6) Who do you sell the soybean yield for? (Poles 22-28). It is the data of yield sale of the farmers who they sell the yield to in order to study the marketing method divided into several topics as follows:

- Pole 22: Ask and record the data of soybean buyers. If they are factories, indicate the names of the factories. If none, indicate in the other field to specify the type of buyers as provided the data by the informant farmers. After having known the type of buyers, fill the data of details in Poles 23-28 further. The data must be in the same row as the type of buyers. Each can have more than 1 type of buyers.

- Poles 23-24: Ask and record the data of grades of the yield to be sold specified as grades A, B, C, oil, or exported. In pole 23, indicate the quantity in the unit of kilogram. In Pole 24, indicate the price in the unit of kilogram.

- Poles 25-26: Ask and record the data of grades of the yield to be sold in mixed grades. In Pole 25, indicate the quantity in the unit of kilogram. In Pole 26, indicate the price in the unit of kilogram.

- Pole 27: Ask and record the data of distance which the farmer households transport the yield from the plots to be sold at the buying source in the unit of kilometer.

- Pole 28: Ask and record the data of transportation cost of the yield from the farmer households to the buying source in the unit of baht per total yield. If there is no transportation cost, it must be specified as free/sold at the plot/the merchants come to take the yield by themselves.

(5) Record of other situations/comments/ suggestions: The officials can record information, situations, comments, and suggestions in the field to provide information for analysis and report the results.

Question 4 It is the inquiry on the causes of increase or reduction of the cultivation areas and the yield per ha occurring or expecting to occur for the soybean in the crop year of 2016/17 of the sample households.

Code of causes

Increase = 1 Reduce= 2 Remain the same = 3

Causes of increase or reduction of the cultivation areas (specify only 1 main cause)

Price in the past year = 1

Weather condition = 2

Plant substitution / other crops (specify plant name)= 3

Others (specify) = 4

Causes of increase or reduction of the yield per ha (specify only 1 main cause)

Maintenance = 1

Water amount = 2

New varieties = 3

Natural disaster (flood, drought ...)	= 4
Disease, insect, rodent epidemic	= 5
Others (specify).....	= 6

The surveyors will mark the circle surrounding the codes of the cause of increase / reduction of the cultivation areas and the yield per rai differently between Question 1 (last year) and Question 3 (this year) following the reality of the area.

- For the planting area, if the cause is selected as **increase** (circle / cross) Code 1 and specify the cause (circle / cross) **Code 3** Planting other plant in substitution / Planting other crops, identify the name of the plant to replace soybean such as planting soybean replacing cassava, specify the name of the plant as "cassava".

- For the planting area, if the cause is selected as **decrease** (circle / cross) Code 2 and specify the cause (circle / cross) **Code 3** Planting other plant in substitution / Planting other crops, identify the name of the plant to replace soybean such as planting cucumber replacing soybean, specify the name of the plant as "cucumber".

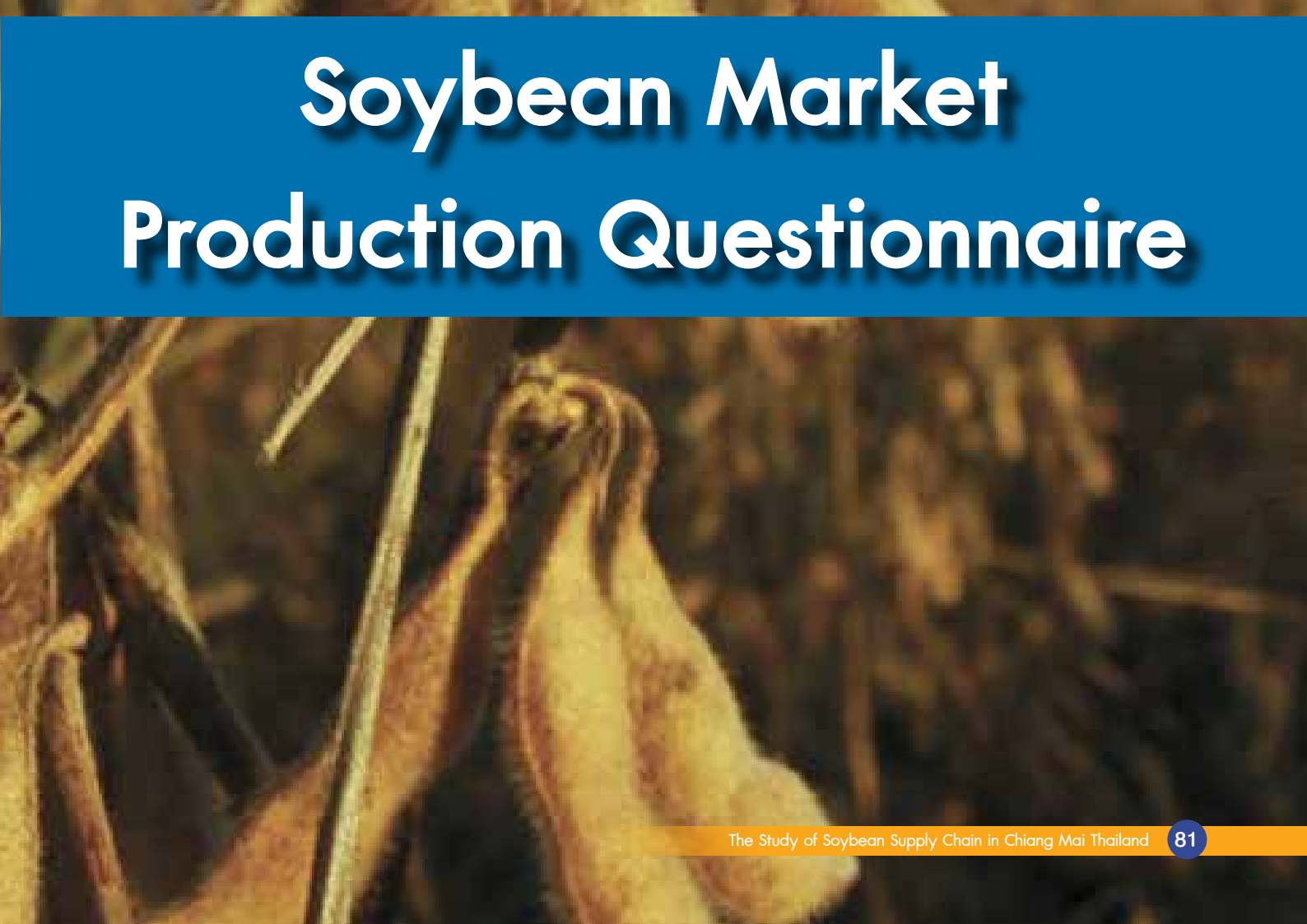
- For the planting area, if the cause is selected as **Remain the same** (circle / cross) Code 3 and specify shortly such as way of life planting source, royal project promotion area, etc.

- For the planting area, if **Code 4 Others (specify)** is selected, specify shortly such as increasing – reducing from the promotion of private/public sectors sold the land to the investors/buying the new land/not renting the land/renting more land, etc.

- For the yield per rai, if selecting the causes of **increase - decrease** in case of not having the causes of Codes 1-5, choose **Code 6 Others (specify)**. In the indication filed, indicate the causes shortly such as eaten by the oxen, flood, compost fertilization, hormone injection, etc.

A close-up photograph of several soybean pods hanging from a stem. The pods are light brown and appear to be drying. The background is a clear blue sky.

Appendix 3

A close-up photograph of soybean pods on a stem, similar to the one above but with a slightly different focus and lighting. The pods are light brown and appear to be drying.

Soybean Market Production Questionnaire



Soybean Market Production Questionnaire

1. Problems and Suggestions on Production

1.1 What is the source of your soybean seeds?

- ☐ Own seeds ☐ From neighbors
☐ From trader ☐ Others

1.2 Are you aware that using Rhizobium can increase soybean production?

- ☐ Yes ☐ No

1.3 Do you use Rhizobium in your production?

- ☐ Yes ☐ No, if answer no please go to question 1.4

1.4 What is your reason of not using Rhizobium?

- ☐ Do not believe that it can increase yield
☐ Cannot find places to buy
☐ Already tried but failed
☐ Others

1.5 Where did you learn about soybean production?

- ☐ Department of Agriculture ☐ Department of Agriculture Extension
☐ Agricultural Cooperatives ☐ Private Sectors.....

2. Soybean market

2.1 Do you think that minimum price of soybean should be guaranteed?

- ☐ Yes, because..... The reasonable price should be.....
☐ No, because

2.2 How did you sell soybean?

- ☐ Grading ☐ Mixed because

2.3 What is the selling methods of soybean that is most beneficial to you?

- ☐ Own sales ☐ Group sales
☐ Contract Farming

2.4 What are problems or issues from selling soybean?

.....
.....

2.5 If not soybean, which crop would you plant?

.....
.....





Appendix 4

Soybean Production Cost Questionnaire





Questionnaire on Production Cost of Soybean (Wee Season/Dry Season) Crop year 2017/18

The shared information will remain confidential and only public information will be disseminated in statistical estimation

A. Details of sample farmer Identification																									
Name of Head of Household.....				House No.....		Village No.....		Sub-district.....		District.....		Household sample No.....													
Province.....				Telephone.....		Date of survey.....		OAE Regional Office No.....																	
<div style="display: flex; justify-content: space-between;"> <div> For Central Office <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>Area</th> <th>Province</th> <th>District</th> <th>Sub-district</th> <th>Village No.</th> <th>Group No.</th> <th>Household Sample No.</th> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table> </div> <div> GPS Coordinates E N Landmarks..... </div> </div>												Area	Province	District	Sub-district	Village No.	Group No.	Household Sample No.							
Area	Province	District	Sub-district	Village No.	Group No.	Household Sample No.																			
B. General information for sample plot (or sample household)																									
1. Planting Methods		<input type="checkbox"/> Sowing		<input type="checkbox"/> Drill planting		<input type="checkbox"/> Hill planting																			
2. Soybean varieties		<input type="checkbox"/> Chiang Mai 60		<input type="checkbox"/> Chiang Mai 21		<input type="checkbox"/> Nakorn Sawan 1		<input type="checkbox"/> Other (Specify)																	
3. Water absorption		<input type="checkbox"/> Pump water from irrigation canals/natural water sources		<input type="checkbox"/> Pump water from the groundwater well		<input type="checkbox"/> let water enter planting field		<input type="checkbox"/> Rainwater																	
4. Planted area		hactare		Harvested area		hactare																			
5. Total production output																									
Sample plot		Grand total				Kilograms (for sales and not for sales)																			
		Yield Distribution		At the farm		At the market																			
				Quantity (Kg)	Price (Kg)	Quantity (Kg)	Price (USD/Kg)	Transportation cost (USD)	Distance (k.m.)																
		(1)	(2)	(3)	(4)	(5)	(6)	(7)																	
		Dry seed with a moisture content not exceeding 14%																							
		Seed with a moisture content specified%																							
6. Land rental		1		Rental area.....hactare		2		Own land area.....hactare																	
		Actual rental fee or estimated cash		Rental fee per season.....USD/Ha		Annual rental fee.....USD/Ha		USD/Ha																	

C. Materials and other expenses for sample plot							D. Labor used in sample plot					80							
Items	Unit Specify	Price USD/Unit	Purchase		Owned materials / Free		Activities (1)	Quantity of work in sample plot				Work Capabilities Per day, Per ha	Wage Rate Per day\ Per labor						
			Quantity	Value (USD)	Quantity	Value (USD)		Total	Hired	Self-labor	Per Ha			(7)					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(1)	(2)	(3)	(4)	(5)	(6)	(7)						
<div>Land preparation steps according to planting methods</div> <div> ☆ Several tillages might be required. In each tillage activity, Specify..... ☆ </div>							1. Land Preparation (if farmers hire lump sum contract) asks what type of activities are included												
							1) Primary Tillage Specify.....							.....Ha	.....	.....	.....Ha	.....
							By Two-wheeled Tractor							.....Ha	.....	.....	.....Ha	.....
							By Tractor							.....Ha	.....	.....	.....Ha	.....
							2) Secondary Tillage Specify.....							.....Ha	.....	.....	.....Ha	.....
							By Two-wheeled Tractor							.....Ha	.....	.....	.....Ha	.....
							By Tractor							.....Ha	.....	.....	.....Ha	.....
							3) Tertiary Tillage Specify.....							.....Ha	.....	.....	.....Ha	.....
							By Two-wheeled Tractor							.....Ha	.....	.....	.....Ha	.....
							By Tractor							.....Ha	.....	.....	.....Ha	.....
4) Grooving							.....Ha	.....	.....	.....Ha	.....							
By Man							.....Ha	.....	.....	.....Ha	.....							
By Machine							.....Ha	.....	.....	.....Ha	.....							
5) Add soil amendment							.....Ha	.....	.....	.....Ha	.....							
By Man							.....Ha	.....	.....	.....Ha	.....							
By Machine							.....Ha	.....	.....	.....Ha	.....							

C. Materials and other expenses for sample plot (Continued)							D. Labor used in sample plot (continued)					82	
Items	Unit	Price USD/Unit	Purchase		Owned materials / Free		Activities	Quantity of work in sample plot		Work Capabilities Per day, Per labor	Wage Rate		
			Quantity	Value (USD)	Quantity	Value (USD)		Total	Hired		Self-labor	Per Ha	Per day/ Per labor
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2.3) Chemical fertilizer							00) Chemical fertilizer application Total.....Times Ask only one time when applied in the area of the same size. Ask more if applied in area of the different						
Grade 46-0-0	Bag	.....	.....	.....	.....	.....	By Man labor	.....Ha	.....	.....	.....Ha	.....	.....
Grade 21-0-0	Bag	.....	.....	.....	.....	.....	By Machine	.....Ha	.....	.....	.....Ha	.....	.....
Grade 15-15-15	Bag	.....	.....	.....	.....	.....		
Grade	Bag	.....	.....	.....	.....	.....		
Grade	Bag	.....	.....	.....	.....	.....		
Grade	Bag	.....	.....	.....	.....	.....		
3. Herbicides													
3.1) Weed control							1) Plant immunization Weed killing Total.....times Ask only one time when applied in the area of the same size. Ask more if applied in area of the different						
Liquid formula, specify.....	Litre	.....	.....	.....	.....	.....	(1) Hand Pump Backpack Sprayer.....Times	.....Ha	.....	.....	.....Ha	.....	.....
Liquid formula, specify.....	Litre	.....	.....	.....	.....	.....	(2) Battery-Powered Backpack Sprayer.....Times	.....Ha	.....	.....	.....Ha	.....	.....
Liquid formula, specify.....	kg	.....	.....	.....	.....	.....	(3) Pump Backpack Sprayer 200 Litre.....Times	.....Ha	.....	.....	.....Ha	.....	.....
3.2) Weed killer							(4) Pump Backpack Sprayer 000 Litre.....Times	.....Ha	.....	.....	.....Ha	.....	.....
Glyphosate	Litre	.....	.....	.....	.....	.....		
Gramoxone	Litre	.....	.....	.....	.....	.....		
Roundup	Litre	.....	.....	.....	.....	.....		
Other Specify.....	.....	.....	.....	.....	.....	.....	
4. Herbicides							2) Plant Immunization Pests and Diseases Control Total.....times Ask only one time when applied in the area of the same size. Ask more if applied in area of the different						
4.1) Disease protection chemical control													
Liquid formula, specify.....	Litre	.....	.....	.....	.....	.....	(1) Hand Pump Backpack Sprayer.....Times	.....Ha	.....	.....	.....Ha	.....	.....
Liquid formula, specify.....	Litre	.....	.....	.....	.....	.....	(2) Battery-Powered Backpack Sprayer.....Times	.....Ha	.....	.....	.....Ha	.....	.....
Liquid formula, specify.....	Litre	.....	.....	.....	.....	.....	(3) Pump Backpack Sprayer 200 Litre.....Times	.....Ha	.....	.....	.....Ha	.....	.....
Liquid formula, specify.....	kg	.....	.....	.....	.....	.....	(4) Pump Backpack Sprayer 000 Litre.....Times	.....Ha	.....	.....	.....Ha	.....	.....
Liquid formula, specify.....	kg	.....	.....	.....	.....	.....		
Liquid formula, specify.....	kg	.....	.....	.....	.....	.....		

C. Materials and other expenses for sample plot (Continued)							D. Labor used in sample plot (continued)					84	
Items	Unit	Price USD/Unit	Purchase		Owned materials / Free		Activities	Quantity of work in sample plot			Work Capabilities Per day, Per labor	Wage Rate Per Ha	
			Quantity	Value (USD)	Quantity	Value (USD)		Total	Hired	Self-labor			Per Ha
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
6. Energy related costs							3.3 Grass cutting/ Grass plucking Total.....times Ask only one time when applied in the area of the same size. Ask more if applied in area of the different size						
6.1) Fuel cost							By man (cutting + plucking) .....times Ha 						
1) Fuel for water pump Litre 							By lawn mover, lawnm tractor.....times Ha 						
2) Fuel for sprayer Litre 							3.4 Soil shoveling/spading Total.....times Ask only one time when applied in the area of the same size. Ask more if applied in area of the different size						
3) Fuel for lawn mower Litre 							By Man labor Ha 						
6.2) Lubricant cost							By Machine Ha 						
1) Lubricants for water pump Litre 							3.5 Watering Total.....times Ask only one time when applied in the area of the same size. Ask more if applied in area of the different size						
2) Lubricants for sprayer Litre 							By Man (Switch on-off) .....Times Ha 						
3) Lubricants for lawn mover Litre 							By Man and water pump (by gas) .....Times Ha 						
6.3) Electricity cost							By Man and water pump (by electricity) .....Times Ha 						
1) For water pump unit/amp 							3.6 Rodenticides, Bird Poison Total.....times Ask only one time when applied in the area of the same size. Ask more if applied in area of the different size						
2) For sprayer unit/amp 							By Man labor Ha 						
7. Consumables and other costs							4. Harvesting						
7.1) Consumables with less than 1 year life span							01) Yield harvesting						
1)							By Man (per area) Kg 						
2)							By Machine (per area) Ha 						
3)							07) Yield collecting to threshing area						
4)							By Man Ha 						
5)							By Man Kg 						
6)							By Machine Ha 						
7.2) Other costs							By Machine Kg 						
1) Rental fee for water pump USD/season 							06) Yield Threshing						
2)							By Man Kg 						
3)							By Machine Kg 						

The background of the entire page is a close-up, slightly blurred photograph of numerous light-brown, oval-shaped soybean seeds. The seeds are densely packed, with some in sharp focus in the foreground and others blurred in the background, creating a sense of depth. The lighting is warm, highlighting the natural texture and color of the seeds.

Appendix 5

Soybean Production Cost Handbook



Appendix 5 Soybean Production Cost Handbook

Chapter 1

Definitions for the survey on soybean production cost

The definitions for the survey on soybean production cost is very important as the obtained data is needed to be clear and beneficial for the surveyors, analysts, and data users. The survey on the data collection of soybean production has the statements related to both particular definition of soybean production cost and general definition as follows:

1.1 Particular definition of soybean production cost

1.1.1 Soybeans in Thailand are divided into 2 generations;

Soybean wet season in the crop year of 2017/18 refers to the soybeans planted by the farmers in the rainy season from 1st May to 31st October, 2017, without considering when the yield will be harvested.

Soybean dry season in the crop year of 2017/18 refers to the soybeans planted by the farmers in the rainy season from 1st November 2017 to 30th April, 2018, without considering when the yield will be harvested.

1.1.2 Tenants who grow the soybeans refer to the farmers of soybeans for more than 0.16 ha having the occupied land in the boundaries of the surveyed provinces without considering where the tenants are settled.

1.1.3 Planting areas refer to the size of land for planting soybeans in each plot with the deduction of the area which cannot be planted of over 0.02 ha in such farm such as residences, ridges, anthill, trees, ponds, fish ponds, shelters, animal pens, etc., which are when being removed, they will be considered as the total planted area.

In case of damage occurring after planting, if there is the re-planting or not re-planting, when the total area is less than the first planted area, the first planted area is used. However, if the replanted area is more than the area planted for the first time, then the replanted area is more than the original area, then use the last planted area.

1) In the first time of planting for 0.8 ha, if the damage occurs for 0.16 ha and there is no replanting, 0.8 ha will be used. If the replanting is for 0.16 ha or less than 0.16, 0.8 ha will be used.

2) In the first time of planting for 0.8 ha, if the damage occurs for 0.16 ha and the replanting is for 0.32 ha and new planting for 0.16 ha, the new planting will be included as 0.96 ha.

1.1.4 Harvesting areas refer to the harvested area of the yield obtained in each plot of land or the harvested areas refer to the cultivation areas deducted with the damaged areas.

Damaged area means the area which cannot be harvested. The damage is partly or completely in each part or in the same plot with the total area of over 0.02 ha. However, if the total area spread over the plot is less than 0.02 ha meters, it will not be considered as damaged area.

1.1.5 Yield refers to the quantity of soybeans which the farmers obtained from the total harvest without considering whether the obtained yield will be for selling, for cultivating, or for other benefits excluding the left yield.

1.1.6 Soybean yield refers to the soybean seeds which are dry and removed from the pads at the humidity of 15%.

1.1.7 Soil preparation means taking the previously planted areas to carry out the activities by ploughing or leveling until it can be planted. This does not include forest exploring or excavating.

1.1.8 Planting refers to taking the seeds to be sown or sprinkled in the soil.

1.1.9 Varieties refer to the varieties of soybeans that have been cultivated by the farmers which are SJ. 4, SJ. 5, ChM. 2 ChM. 60, NW. 1, STh. 1 STh. 2, MKh. 35, Chakkraphan, etc.

1.1.10 Harvesting refers to the total activities from harvesting the soybean yield, padding, and drying until receiving the yield of seeds.

1.1.11 Transportation refers to transporting the seeds from another place to the plot of land or transporting the yield gained from the plot to be collected on the road before selling or storing or to any other process. This excludes the transportation to be sold at the factories or buying sources. The transportation can be made by human, animals, machines, and the acts are the clear activities.

1.1.12 Sale refers to the sale of soybeans after harvesting with several selling methods such as selling at the fields, selling to local merchants, etc.

In case of not selling at the fields, the transportation costs are needed to be asked as the data can be used for studying the transportation rates and value of yield at the fields.

1.2 General definitions

1.2.1 Wage rates of general workers refer to the wages paid to the workers working per day (8 hours) for local work.

1.2.2 Wages for soil preparation refer to the costs of labor in preparing the soil for each step until it can be planted such as ploughing, leveling, etc.

In case of machinery hire, no depreciation, repairing, and oil of the machine are calculated because they are already included in the wages.

1.2.3 Wage payment refers to the cost of the wages paid for the labor in planting including the labor costs from transporting the seeds to be stored in the plot of land to be planted in the plot.

1.2.4 Wages paid for fertilization refer to the expenses incurred as the payment of wages for fertilization and sprinkling the fertilizer. This includes the labor costs from moving the fertilizer from the storage place to the cultivation plot or to be prepared in the planting area.

1.2.5 Cash wages refer to the amount paid by the employer in cash and it is the non-farmer's wage to work in plant production activities.

1.2.6 Evaluation wages refer to the costs of assessing the wages paid to the labor in the grower households who are engaged in the production activities calculated based on local wage rates.

1.2.7 Wage rates for weed / pest removal by human labor refer to the wage rates in hiring both manpower and pump without calculating the depreciation and repair costs of the pump.

1.2.8 Wage rates for weed / pest removal by machine labor refer to the wage rates in hiring both machinery and human labor without calculating the depreciation and repair costs of the machine to spray the pesticide.

1.2.9 Wage rates for harvesting refer to the costs from paying the money as the wages for harvesting activities including related activities. In case of soybean harvesting, it is possible to hire both workers and machines by calculating 2 types of wage payment:

- 1) Calculate the wage rates for the areas such as the wages in baht per ha.
- 2) Calculate the wage rates for the yield such as the wages in baht per kilogram.

1.2.10 Fertilizer refers to the plant nutritional food including chemical fertilizers, biological fertilizers, organic fertilizers such as manure, manure.

1.2.11 Weed removal refers to grass cutting and soil loosening

- **Grass cutting** refers to cutting the grass or weed not to disturb the plants.
- **Soil loosening** refers to loosening the soil around the base of the tree to eliminate weeds and to enable the soil to get water and fertilizer conveniently.

1.2.12 Weeds are grasses or plants that are not planted and do not need to be planted in the plots as they grasp the nutrition in the soil causing the plants to become infertile.

1.2.13 Pests mean the things that destroy plants or yield including fungi, insects, worms, rats, birds, squirrels, etc.

1.2.14 Weed control means herbicide that kills the non-cultivated plants in the plots.

1.2.15 Pesticides means insecticides to kill worms, aphids, fungi and other pests.

1.2.16 Spraying the weed / pest control means spraying the insecticide to kill pests and weeds in the plots classified by the use of labor or equipment as follows:

- 1) Spraying the weed / pest control by man means one man can spray by carrying the sprayers as the pump, light engine, etc.
- 2) Spraying the weed / pest control by machine means using the human-controlled engine such as spraying tractor, pumping from 200-liter, 1,000-liter, or 2,000-liter buckets and drag the hose which requires at least two persons; the person holding the hose and the person dragging the hose.
- 3) Carrying pump refers to the spraying machine using human labor to pump for the air pressure to spray.

1.2.17 Costs of fuel oil and lubricant for the water pump and sprayer refer to the costs incurring from the use of oil only for the water pump and sprayer of weed / pest control.

1.2.18 Repair cost means the cost of repairing damaged agricultural equipment for normal use by defining the rounds of usage such as house, ponds, wells, machinery, tools used in the activities in the farms or fields. This excludes the engine repair that has already been hired. In one time of repairs, it must be known how many years to use (one round

of repair) until it will be repaired again. This is used for calculating the average annual repair cost.

1.2.19 Investment opportunity loss cost refer to the estimated cost based on the items of all variable costs which are the compensation for the use of production factors. If they are taken for other activities, the yield will also be given as the returns on the production factors.

$$\text{OPC} = \text{TVC} \times \frac{M}{12} \times r$$

Whereas

OPC = Investment opportunity loss cost (USD/ha)

TVC = Total variable costs per ha

M = Manufacturing duration (months) from starting the production and soil preparation until harvesting

R = Loan interest rates

2.2.20 Land rental cost refers to the costs paid for land benefiting per production season. If there is the rent of yield, the yield must be estimated as money. In case of own land, the land use fee must be estimated equaling to the local rental rates.

2.2.21 Depreciation of assets refers to the costs incurred by the assessment, distribution of the value of purchased assets to each production phase throughout the lifetime of the property calculated per ha. The value will not be shown in cash. The valuation of depreciation can be calculated in several ways. In this case, the linear method is used. It is the easiest and popularly used way to calculate.

$$D = \frac{(BV - EV)}{N} \times \frac{M}{12} \times r \times U \times \frac{1}{A}$$

Whereas

D = Depreciation of assets per year

BV = Basic value of purchasing or creating the assets

EV = Scrap value of assets when being expired to use

M = Manufacturing duration (months) from starting the production and soil preparation until harvesting

N = Usage life of assets

U = Percentage of use of assets in manufacturing such plants

A = Planting areas

In case of hiring labor including the equipment and tools, such tools are not calculated for the depreciation.

2.2.22 Investment opportunity loss cost in the assets refer to the estimated costs of investing in assets such as agricultural equipment, buildings to be calculated for the loss of opportunity to receive the returns from the use in other activities. Such opportunity loss cost is estimated with the loan interest rate of the Bank for Agriculture and Agricultural Cooperatives.

$$\text{OPI} = \frac{(\text{BV} - \text{EV})}{2} \times \frac{\text{M}}{12} \times r \times U \times \frac{1}{A}$$

Whereas

OPI = Investment opportunity loss cost in the assets

BV = Basic value of purchasing or creating the assets

EV = Scrap value of assets when being expired to use

M = Manufacturing duration (months) from starting the production and soil preparation until harvesting

r = Loan interest rate

U = Percentage of use of assets in manufacturing such plants

A = Planting areas

Chapter 2

Survey and interviews

2.1 Survey form

This survey form should be made simply not complicated. The cost activity must be consistent with the farmer's best practice. The sequence of inquiry must be continuous and has the clear definition as standard. The survey form is divided into 5 parts A, B, C, D and E as follows:

Part A Names of the sample farmers: It is used to record the names and the addresses of the sample households for facilitating in searching and checking the information with the computer system.

Part B General Information

Question 1 General information of the sample plots: It is the part to record the details of all plots planted with soybean wet season or dry season as follows:

1. Planting methods: Asking how to plant; sowing, sprinkling in the rows, and dropping in the holes. Then, mark ✓ into the designated box.

2. Planting varieties: Asking about the planting varieties including ChM. 2, ChM. 60, and NW. 1. Then, mark ✓ into the designated box.

3. Water receipt: Asking about the water receipt including pumping from irrigation canal / natural water source, pumping from wells, letting the water to flow into the plots, and the rainwater. Then, mark ✓ into the designated box.

4. Planting / harvesting areas: Asking about the planting and harvesting areas of the soybean wet season or dry season of the sample plots. Then, record the data into the designated spaces.

5. Total yield of the sample plots

- **Total yield:** Asking about the total yield of the sample plots including sales and non-sales. Then, fill the data in the designated spaces.

Pole 1 is the humidity of the yield classified as the dry seed with the humidity of 15% and the humid seeds indicated as%.

Poles 2 –3: Asking about the sale information at the fields. The quantity sold in kilograms in Pole 2. The selling price is in USD / kg in Pole 3. Then, record the data in the questionnaires.

Poles 4-7: Asking about the sale information at the buying sources. The quantity sold in kilograms in Pole 4. The selling price is in USD/kg in Pole 5. The transportation cost is in USD/kg in Pole 6. The distance in the transportation is in USD/km in Pole 7. Then, record the data in the questionnaires.

6. Land rent: Asking and filling the data of the planting area of the sample households whether they own or rent the land (households) and asking about the rental costs paid in cash by the farmers per ha per season or paid per ha per year. If there is no rental, asking about general rental cost in the local areas and record in the spaces.

If there is the rent of yield, the yield must be estimated as money as well.

Part C Materials and other costs used with the sample plots

Asking about the data of the material costs and other costs of the sample plots in Pole 1 as the designated items and in Pole 2 as the units of each item. Then, ask the data correspondent with the items in Pole 1 as follows:

Question 1 Varieties: Asking about the seeds used in planting whereas:

Pole 3: Asking and filling the data at the price of USD per kg. Then, record the data in the questionnaires.

Pole 4 and Pole 5: Asking about the quantity of seeds and the purchased value to fill the data in the questionnaires.

Pole 6 and Pole 7: Asking and filling the data of the quantity of seeds and the value of seeds of their own or gained with free of charges (price estimation)

Question 2 Fertilizers: Asking about the use of fertilizers consisting of organic fertilizer, biological fertilizer, and chemical fertilizer which are the items already defined in Pole 1 and the unit of fertilizer in Pole 2. Then, ask the information as follows:

2.1 Organic fertilizer: Asking and filling the data of the use of organic fertilizer such as chicken manure, duck manure, pig manure, dung and other manure whereas:

Pole 3: Asking and filling the data of fertilizer price at the price of USD per kg. Then, record the data in the questionnaires.

Pole 4 and Pole 5: Asking and filling the data of quantity and price of fertilizer in the questionnaires.

Pole 6 and Pole 7: Asking and filling the data of the quantity and price of fertilizer of their own or gained with free of charges (price estimation) in the questionnaires.

2.2 Biological fertilizer: Asking and filling the data of the use of biological fertilizer such as tablet biological fertilizer and liquid biological fertilizer in the units of kilograms or liters by asking as same as in 2.1. Then, record the data in the questionnaires.

2.3 Chemical fertilizer: Asking and filling the data of the use of chemical fertilizer with formula such as formula 46-0-0, formula 21-0-0, formula 16-20-0, etc. by asking as same as in 2.1. Then, record the data in the questionnaires.

Question 3 Weed control chemical substance: Asking about the use of weed control chemical substance consisting of weed control and herbicide which are the items

already defined in Pole 1 and the unit of chemical in Pole 2. Then, ask the information as follows:

3.1 Weed control: Asking and filling the data of the use of weed control both liquid and powder by indicating the names of the substance or any other symbol in Pole 1 and asking as follows:

Pole 3: Asking and filling the data of weed control price at the price of USD/liter (liquid) or USD/kg (powder).

Pole 4 and Pole 5: Asking and filling the data of quantity and price of weed control purchase in the questionnaires.

Pole 6 and Pole 7: Asking and filling the data of the quantity and price of weed control of their own or gained with free of charges (price estimation) in the questionnaires.

3.2 Herbicide: Asking and filling the data of the use of herbicide such as Glyphosate, Gramoxone, Round-up in the unit of liter and the powder in the unit of kilogram. If there is any other item apart from those mentioned above, put it in the next item along with indicating the name of the herbicide by asking the information as same as in 3.1.

Question 4: Pesticide substance: Asking about the use of pesticide substance consisting of insecticide, pesticide of worms, aphids which is the item already defined in Pole 1 and the unit of pesticide substance in Pole 2. Then, ask the information as follows:

4.1 Disease prevention: Asking and filling the data of the use of disease prevention in the liquid form in the unit of liter and in the powder form in the unit of kilogram by specifying the name of the disease prevention or any other symbol in Pole 1 and asking the data as same as in 3.1.

4.2 Insecticide, pesticide of worms, aphids: Asking and filling the data of the use of insecticide such as Methamidophos, Abamectin. If there is any other item apart from those mentioned above, put it in the next item along with indicating the name of the substance by asking the information as same as in 3.1.

Question 5 Other chemical and soil improvement material: Asking about the use of other chemical and soil improvement material which is the item already defined in Pole 1 and the unit of other chemical and soil improvement material in Pole 2. Then, ask the information as follows:

5.1 Other chemical: Asking and filling the data of the use of other chemical such as hormone (liquid) and hormone (powder) in the unit of liter and the powder in the unit of kilogram. Then, ask the information as follows. If there is any other item apart from those mentioned above, put it in the next item along with indicating the name.

Pole 3: Asking and filling the data of price of other chemical at the price of USD/liter (liquid) or USD/kg (powder).

Pole 4 and Pole 5: Asking and filling the data of quantity and price of purchase of other chemical in the questionnaires.

Pole 6 and Pole 7: Asking and filling the data of the quantity and price of their own or gained with free of charges (price estimation) in the questionnaires.

5.2 Soil improvement material is the substance for soil improvement, Dolomite (marl), limestone. If there is any other item apart from those mentioned above, put it in the next item along with indicating the name by asking for the information as same as in 5.1. Then, record the data in the questionnaires.

Question 6 Expenses about the energy use: Asking about the use of fuel oil, lubricant, and electricity charge which is the item already defined in Pole 1 and the unit as defined in Pole 2. Then, ask the information as follows:

Pole 3: Asking and filling the data of fuel oil price at the price of USD/liter

Pole 4 and Pole 5: Asking and filling the data of quantity and price of purchase of fuel oil in the questionnaires.

Pole 6 and Pole 7: Asking and filling the data of the quantity and price of their own or gained with free of charges (price estimation) in the questionnaires.

Question 7 Use of consumable materials and other expenses: Asking about the use of consumable materials with the usage life of not over 1 year with the price per unit for not over USD 15 and other expenses which is the item already defined in Pole 1 and the unit of material cost in Pole 2. Then, ask the information as follows:

7.1 Cost of consumable materials with the usage life of not over 1 year including knives, hoes, spades, baskets, water buckets, and others. Then, record the data as follows:

Pole 3: Asking and filling the data of price in USD/unit

Pole 4 and Pole 5: Asking and filling the data of quantity or amount of purchased materials and fill in the questionnaires.

Pole 6 and Pole 7: Asking and filling the data of the quantity and price of their own or gained with free of charges (price estimation) in the questionnaires.

7.2 Other expenses including the transportation costs of materials, rental cost of the water pump, vehicle cost for workers, meal cost for welcoming the guests, and other costs by asking for the data of expenses for the entire season and recording the data as same as in 7.1.

Part D Labor use: It is the inquiry on the labor use in the activities such as soil preparation, planting, care, and harvesting with the details as follows:

Question 1 Soil preparation: Asking for the data about the labor cost in the soil preparation such as ploughing, leveling, putting the materials for soil improvement before planting operated with machines and human labor which are the items already defined in Pole 1. Then, ask the information as follows:

Poles 2-10 Asking and filling the data about the quantity of works hired or made by themselves in the sample plots as follows:

Pole 2 Asking and filling the data about the number of hired workers

Pole 3 Asking and filling the data about the number of days of hired labor

Pole 4 Asking and filling the data about the number of ha of hired labor

Pole 5 Asking and filling the data about the number of own workers

Pole 6 Asking and filling the data about the number of days of own labor

Pole 7 Asking and filling the data about the number of ha of own labor

Pole 8 Asking and filling the data about the number of combined workers

Pole 9 Asking and filling the data about the number of days of combined labor

Pole 10 Asking and filling the data about the number of ha of combined labor

Pole 11 Asking and filling the data about the capabilities in working per day in the unit of ha meaning in 1 day (8 working hours), 1 grower can work for how many ha.

Poles 12-13 Asking and filling the data about the labor cost wage rates in the unit of baht / rai in Pole 12 and baht / labor in Pole 13.

Question 2 Planting: Asking for the data about the labor cost in planting including planting by sowing the seeds, sprinkling in the rows, and dropping in the holes working solely with human labor or machines and human labor which are the items already defined in Pole 1. Then, ask the information as follows:

Poles 2-13 Asking and filling the data as same as in Question 1, soil preparation.

Question 3 Caring is asking for the data about the labor use in caring including fertilization, spraying the control substance, herbicide, and insecticide, grass cutting/grass removal, soil loosening, watering, and pesticide which are the items already defined in Pole 1. Then, ask about the total times for fertilization. The questions are as follows:

3.1 Fertilization: Asking and filling the data of times for fertilization and about the labor cost in fertilization operated by human labor or the machine and human labor. The questions are as follows:

Poles 2-13 Asking and filling the data as same as in Question 1, soil preparation.

3.2 Control for prevention: Asking for the data about the labor cost in controlling for prevention, herbicide, insecticide, and other substance injection operated by human labor and the pumping injector, motor injector, sprayer by pumping from the 200-liter buckets and 1,000-liter buckets. The questions are as follows:

Poles 2-13 Asking and filling the data as same as in Question 1, soil preparation.

3.3 Grass cutting/grass removal: Asking for the data about the labor cost in grass cutting/grass removal operated by human labor or the lawn mowers. The questions are as follows:

Poles 2-13 Asking and filling the data as same as in Question 1, soil preparation.

3.4 Soil loosening: Asking for the data about the labor cost in soil loosening operated by human labor and machines. The questions are as follows:

Poles 2-13 Asking and filling the data as same as in Question 1, soil preparation.

3.5 Water giving: Asking for the data about the labor cost in water giving operated by human labor and water pump (using oil), human, and pump (electrical), human labor and machines. The questions are as follows:

Poles 2-13 Asking and filling the data as same as in Question 1, soil preparation.

3.6 Pesticide: Asking for the data about the labor cost in putting pesticide operated by human labor. The questions are as follows:

Poles 2-13 Asking and filling the data as same as in Question 1, soil preparation.

Question 4 Harvesting: Asking for the data about the labor cost in harvesting activities including the yield harvesting, yield collection to the park for padding, padding with human labor calculated following the areas, human calculated following the yield (seeds), and machine calculated following the areas, machine calculated following the yield which are the items already defined in Pole 1. The questions are as follows:

Poles 2-13 Asking and filling the data as same as in Question 1, soil preparation.

Part E Asking for the data of tools, equipment, and houses used in cultivating the soybeans. The questions are as follows:

Poles 1 – 5 is the inquiry on the items of tools, equipment, and houses with the usage life of over 1 year with the value per unit of more than USD 15 used in the planting plots as shown below:

Pole 1: The items of tools, equipment, and houses as defined. If there is any other item apart from those mentioned above, please specify

Pole 2 Asking and filling the data of total unit of the tools, equipment, and houses such as pieces, etc.

Pole 3 Asking and filling the data of total initial purchasing price (baht)

Pole 4 Asking and filling the data of value when selling the scrap (baht)

Pole 5 Asking and filling the data of number of usage year from making the decision to buy until the expiry of usage life per piece (year).

Poles 6 -8 Asking for the data about the repairing of tools, equipment, and houses occurring in 1 year with the following activities, (1 year following the cultivation season. The wet season is from the 1st May to 31st October, 2017, and the dry season is from 1st November to 30th April, 2018).

Pole 6 Asking and filling the data of hiring for repairing in the planting year (USD)

Pole 7 Asking and filling the data of repairing by themselves by estimating the repairing value (USD).

Pole 8 Asking and filling the data of usage life after having repaired (years).

Pole 9 Asking and filling the data of usage percentage with the sample plots of this plant, for example, the usage percentage to know the operation of “pumping sprayer” with the soybean of the sample plots.

Asking about the use percentage can be done as follows:

Asking about the use area with the pumping sprayer to know how many ha there are and calculating to find the % of usage by bringing the sample plots to be deducted with the use area with the total pumping sprayers by 100.

3.2 Interview on the production cost data

Initially, the surveyors must know how the field is or activity of planting until the yield can be harvested in order to know how the farmers should do as well as understanding the survey form and the definitions must be accurate to complete the data record. In interviewing the sample households, the surveyors should provide the opportunity for sample households to order the planting sequence according to the activities. While listening to the farmers, the surveyors must keep the subject matter and then record it in the survey form periodically as well as inserting the questions if the data is still missing or incomplete.

For some information, the surveyors should be memorized in order to ask if the farmer provides the information that may be inaccurate. The yield per ha should be based on possible criteria both higher and lower. When the farmers tell about all yields received. Moreover, if the yield and the planting area are calculated abnormally, it will be repeatedly asked for certainty.

Trying to know the amount of fertilizer, herbicide, insecticide, pesticide, water supply to be used including the use per time, number of times and duration in each time and how many days in difference. If using too many times, it will cause damage to plants. Or if using too many times or more frequent, or exceeding the suitable times than necessary, it will be not consistent with the way it is performed or the time it should be. The data is considered inaccurate from the truth. It will be asked to correct. Or the amount of fertilizer used to increase or decrease abnormality, please note and ask the farmers whether they use other types of fertilizers or not such as may reduce the use of chemical fertilizers because it is expensive. This may result in the total fertilizer value per ha. Decreasing from the previous production.

☐ Capabilities in working with various activities can be calculated by calculating the average of one day or one time when the total number of hired laborers is equal to the total work load such as cultivation using calculation formula as follows:

$$\text{Capabilities of growing per day} = \frac{\text{The area planted on that day (ha)}}{\text{Number of human labor planting on that day (men)}}$$

☐ Wage rate using the calculation formula as follows:

$$\text{Wage rate in baht per rai} = \frac{\text{Wage rate (USD per day)}}{\text{Capabilities in working such activities (Unit per day)}}$$





Appendix 6

Entrepreneur Survey (buying Soybean)



Entrepreneur Questionnaire (Buying soybean)

Section 1 General Information

Name of establishment.....Location/Address.....
 Telephone Number.....Name - Last Name of contact person.....Position.....
 Type of establishment (Warehouse, purchase yeard, cooperative, etc.).....

1. Variable cost

1.1 Sorting

- Labor costUSD/kg.
- Material cost e.g. sack, ropeUSD/kg.
- Other (Specify)USD/kg.

Yield purchased over the year

Yields sold throughout the year

1.2 Enterprising cost

- Labor cost Number of labor..... Wage.....USD/month
- Water supply cost.....USD/year
- Electricity cost.....USD/year
- Meal cost.....USD/year
- Other cost (specify).....USD/year
- Other cost (specify).....USD/year

1.3 Transporting cost

Purchasing

Selling

- | | |
|--|--|
| - Fuel cost.....USD/year | - Fuel cost.....USD/year |
| - Driver cost.....USD/year | - Driver cost.....USD/year |
| - Lifter cost.....USD/year | - Lifter cost.....USD/year |
| - Consumables cost e.g. oil.....USD/year | - Consumables cost e.g. oil.....USD/year |
| - Other (Specify).....USD/year | - Other (Specify).....USD/year |

2. Fixed cost

Items	Number	Initial Value (USD)	Useful Life (USD)	Scrap Value (USD)	Repair cost during the year (USD)
- Building/Warehouse					
- Machine/Screening machine					
- Car/specify type.....					
- Machine specify.....					
- Other specify					
-					
-					
-					
- Tax cost.....USD/year					

Entrepreneur Questionnaire (Buying soybean)

Section 2 Purchasing

Purchaser details No..... Name(Individual/group/other specify.....)

Address/Location.....Telephone number.....

Purchase period (Month)	Quantity (kg)	Purchased grade (Specify e.g. mix, oil ...)	Purchase Price	
			USD per kg	Total (USD)

Purchaser details No..... Name(Individual/group/other specify.....)

Address/Location.....Telephone number.....

Purchase period (Month)	Quantity (kg)	Purchased grade (Specify e.g. mix, oil ...)	Purchase Price	
			USD per kg	Total (USD)

Purchaser details No..... Name(Individual/group/other specify.....)

Address/Location.....Telephone number.....

Purchase period (Month)	Quantity (kg)	Purchased grade (Specify e.g. mix, oil ...)	Purchase Price	
			USD per kg	Total (USD)

Entrepreneur Questionnaire (Buying soybean)

Section 3 Selling

Buyer details No..... Name(Individual/group/other specify.....)

Address/Location.....Telephone number.....

Selling period (Month)	Quantity (Kg.)	Selling grade (Specify e.g. mix, oil ...)	Selling Price	
			USD per kg	Total (USD)

Buyer details No..... Name(Individual/group/other specify.....)

Address/Location.....Telephone number.....

Selling period (Month)	Quantity (Kg.)	Selling grade (Specify e.g. mix, oil ...)	Selling Price	
			USD per kg	Total (USD)

Buyer details No..... Name(Individual/group/other specify.....)

Address/Location.....Telephone number.....

Selling period (Month)	Quantity (Kg.)	Selling grade (Specify e.g. mix, oil ...)	Selling Price	
			USD per kg	Total (Baht)



The background of the entire page is a close-up, high-resolution photograph of dry soybean grains. The grains are light beige or off-white, with some showing a slight purple or brownish tint, particularly around the hilum. They are densely packed and fill the entire frame, creating a textured, granular appearance. The lighting is even, highlighting the smooth, rounded shape of the individual grains.

Appendix 7

Agricultural Product Standard (Dry Soybean Grains)





THAI AGRICULTURAL STANDARD
TAS 4701-2013

SOYBEANS

National Bureau of Agricultural Commodity and Food Standards
Ministry of Agriculture and Cooperatives

ICS 67.060

ISBN 978-974-403-986-6

UNOFFICAL TRANSLATION



THAI AGRICULTURAL STANDARD
TAS 4701-2013

SOYBEANS

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15.	Ms. Chutima Sornsumrarn Office of Standard Development, National Bureau of Agricultural Commodity and Food Standards	Member and Secretary

(3)

Soybeans are high in protein and oil content which are suitable for human consumption, processing for various kinds of food products as well as animal feed. Therefore, the Agricultural Standards Committee deems it necessary to establish the standard for soybeans so that soybeans used in the country meet the quality and safety requirements.

This standard is based on the following document:

Department of Internal Trade. 2005. Policy and Measures for Soybeans B.E. 2548 (2005). Bureau of Agricultural Trading Promotion. Department of Internal Trade. Ministry of Commerce. Bangkok.



NOTIFICATION OF THE MINISTRY OF AGRICULTURE AND COOPERATIVES
SUBJECT: ESTABLISHMENT OF AGRICULTURAL STANDARD:
SOYBEANS
UNDER THE AGRICULTURAL STANDARDS ACT B.E. 2551(2008)

Whereas the Agricultural Standards Committee, by the resolution at the first session of B.E. 2556 (2013) on 6 March B.E. 2556 (2013), deems it necessary to establish an agricultural standard for soybeans as a voluntary standard in accordance with the Agricultural Standards Act B.E. 2551 (2008) to promote such agricultural commodity to meet its quality and safety standards.

By virtue of Section 5, Section 15 and Section 16 of the Agricultural Standards Act B.E. 2551 (2008), the Minister of Agriculture and Cooperatives hereby issues this Notification on Establishment of Thai Agricultural Standard for Soybeans (TAS 4701-2013), as voluntary standard, details of which are attached herewith.

Notified on 6 April B.E. 2556 (2013)

(Mr. Yukol Limlamthong)
Minister of Agriculture and Cooperatives

THAI AGRICULTURAL STANDARD FOR SOYBEANS

1 SCOPE

This Thai Agricultural Standard applies to commercial variety of soybean grains of *Glycine max* L. Merrill, family Leguminosae, for human consumption, animal feed or oil extraction.

2. QUALITY

2.1 Minimum requirements

- (1) Grain colour of the variety characteristic,
- (2) Free from abnormal odour,
- (3) Moisture content not to exceed 13% by weight.

2.2 Classification

2.1.1 All classes of soybeans shall meet the minimum requirements as of Section 2.1. Classification of classes shall be based on grain size graded by sieve and protein content as in Table 1.

Table 1 Classification of soybeans
(Section 2.2)

Items	Requirements		
	Class 1	Class 2	Class 3
Grain size	Diameter not less than 4.8 mm.	Diameter not less than 4.5 mm.	Mixed size
Protein content	36% or above	Less than 36%	Less than 36%

3. DEFECTS

3.1 Definitions of soybean defects are as follows:

3.1.1 Foreign matter means other matters other than soybeans such as parts of stem, leaf, hull, stone, dirt, wood or other seeds.

3.1.2 Damaged kernel means soybean which has physical deterioration and/or deformity such as shrivelled, insect-damaged, and immature kernel.

3.1.3 Broken kernel means soybean with more than one-fourth of whole kernel removed or split.

3.2 Defect tolerances

The tolerances for each class are shown in Table 2.

Table 2 Defect tolerances

(Section 3.2)

Defects	Tolerance limits in each class (%)		
	Class 1	Class 2	Class 3
Foreign matter	1 Stone and dirt not to exceed 0.5	2 Stone and dirt not to exceed 1	3 Stone and dirt not to exceed 1
Damaged kernel	3	5	8
Broken kernel	3	8	10

4. SIZE TOLERANCES

Tolerances according to the unsatisfied size of class 1 and class 2 shall not be more than 10% by weight.

5. PACKAGING

Soybeans shall be packed in a clean container and be able to prevent external contamination. The containers shall be durable against handling from transportation, able to protect and maintain soybean quality as well as the contamination which may harm the consumers.

6. MARKING AND LABELLING

6.1 Retail container for direct consumers.

The following information shall appear on the container, package, fastening material or tag. They shall be easily and clearly visible without false or deceptive as follows:

- (1) Name of the produce
"Soybean grains" or "Soybeans" and soybean variety
- (2) Class
- (3) Net weight and date of production and/or packing
- (4) Information of producer, and/or re-packer, and/or distributor

Indicate name and address of the producer or re-packer or distributor. Name and address of head office of producer or re-packer or distributor may be provided. For imported soybeans, the importer's name and address shall be indicated.

- (5) Source of origin

Indicate country of production, except local production for domestic market.

- (6) Language

In case of domestic market, label shall be in Thai. However, foreign language may be added.

In case of exported produce, label can be in foreign language.

6.2 Non-retail containers

The following information shall be specified in the document accompanying the shipment, adhered on the label or container. They shall be legible, indelible and not be false or deceptive as follows:

- (1) Name of the produce
"Soybean grains" or "Soybeans" and soybean variety
- (2) Class
- (3) Net weight and date of production and/or packing
- (4) Information of producer, and/or packer, and/or distributor

Indicate name and address of the producer or packer or distributor and identification code (if any). Name and address of head office of producer or packer or distributor may be provided. For imported produce, the name and address of importer shall be indicated.

- (5) Source of origin

Indicate country of production, except produce for domestic market

- (6) Language

In case of domestic market, label shall be in Thai. However, foreign language may be added. In case of exported produce, label can be in foreign language.

6.3 Certification mark

The use of certification mark shall be complied with the Ministerial Regulation on Characteristic of Mark, Application and Display B.E 2553 (2010) and the related Notifications of National Bureau of Agricultural Commodity and Food Standards.

7. CONTAMINANTS

Type and level of contaminants in soybeans shall be complied with the relevant laws.

8. PESTICIDE RESIDUES

Pesticide residues in soybeans shall be in compliance with the relevant laws and the requirements under the Thai Agricultural Standard on Pesticide Residues : Maximum Residues Limits (TAS 9002) and Pesticide Residues : Extraneous Maximum Residues Limits (TAS 9003).

9. HYGEINIC

Soybeans shall be harvested, handled including stored and transported with hygienic practices so as to prevent contamination that may be harmful to consumers.

10. METHODS OF ANALYSIS AND SAMPLING

10.1 Analytical methods are shown in Table 3:

Table 3 Methods of Analysis

Items	Methods of analysis	Principle
Defects (section 3)	Take at least 1 kg of soybean sample then subsample to the final weight of 125 gm. Inspect foreign matter, damaged and broken kernel and calculate the percentage by weight.	Visual inspection
Moisture content (section 2.1)	ISO 6540 or other equivalent analytical methods shall be applied. In case other moisture analytical method i.e., moisture measuring device is used, it must be verified against the hot air oven method. The frequency of verification depends on various factors such as frequency of measurement, number of samples and error of measurement.	Gravimetry By hot air oven method
Protein content (section 2.2)	AOAC 955.04D or other equivalent analytical methods shall be applied.	Titrimetry, Kjeldahl digestion or other methods that are accurate and being accepted shall be used to analyse the percentage of protein content.

Note
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Principles for the selection of other methods of analysis shall be as follows:

1. The methods of analysis notified by national organization or international organization on standardization or published manual or publications which are internationally recognised.
2. The methods shall be validated by the collaborati study in compliance with the criteria of the recognisably international organization.
3. In case of neither point 1 nor point 2 is not available, methods of analysis shall be in accordance with the single laboratory validation which is internationally recognised.

10.2 Sampling

Sampling shall follow methods in Appendix B. The use of other essential sampling methods shall comply with relevant laws and regulations.

APPENDIX A

ILLUSTRATION OF SOYBEAN DEFECTS



Figure A.1 Normal kernels



Figure A.2 Damaged kernels



Figure A.3 Mouldy kernels



Figure A.4 Broken kernels

APPENDIX B

SAMPLING METHODS

B.1 DEFFINITION

Definitions used for sampling of soybeans are as follows:

B.1.1 Lot means a quantity of soybeans delivered at one time and presumes the same characteristics such as origin, type, packing, packer and consigner.

B.1.2 Incremental sample means soybean randomly sampled at certain spots from each lot. The number of spots for sample is calculated by the methods given in Tables B1 and B2.

B.1.3 Aggregate sample or composite sample means total sample obtained from a combination of the incremental samples.

B.1.4 Laboratory sample means an aggregate sample which is mixed homogeneously and reduced in sufficient amount size for laboratory analysis or testing.

B.2 PROCEDURES

Sampling of soybeans shall be properly practiced to obtain a well representative of a lot. For incremental samples, sampling shall be picked regarding the number of spots/ locations depends on a frequency according to pre-calculated information. The spots of sampling shall be distributed entirely the lot. Incremental samples are mixed homogenously for preparation of aggregate sample. An aggregate sample is reduced the size until its weight is double for laboratory sample. The laboratory sample is divided in two parts and placed in a sealed bag. One of sample bag is delivered to laboratory. The rest is kept for traceability in case of problem arising.

B.2.1 Sampling of product in packed units

The frequency of incremental samples taken from packed units shall be calculated by the following formula:

$$F(n) = \frac{m_B m_l}{m_A m_p}$$

where;

$F(n)$ = frequency of sampling from every (n) bag for incremental sample

n = number of packed units per each sampling

m_B = weight of soybeans of the lot in kg

m_i = weight of incremental sample specified as 0.1 kg

m_A = weight of aggregate sample in kg ; in general approximate at 3 kg

m_p = weight of soybeans in each bag in kg

Table B. 1 Example of frequency for taking incremental samples in bag as of proper representative samples for laboratory testing. Samples were taken from lots of 25, 50 and 100 tonnes where incremental sample weight is 0.1 kg.

Soybeans weight in each lot (kg)	Weight in each packed uints (kg)	Frequency of incremental sampling (one sample from every n bag)
25,000	1	833
25,000	5	167
25,000	25	33
25,000	40	21
25,000	50	17
50,000	1	1,667
50,000	5	333
50,000	25	67
50,000	40	42
50,000	50	33
100,000	1	3,333
100,000	5	667
100,000	25	133
100,000	40	83
100,000	50	67

Note: Additional incremental samples can be taken in case of composite sample's weight is less than 3 kg which is not sufficient for analysis in the laboratory.

B.2.2 Soybean sampling from bulk

sampling number for laboratory analysis shall be agreed by the contract parties. Number and size of incremental samples are illustrated in Table B.2. If sample weight for laboratory analysis is not sufficient, number of incremental samples shall be increased.

Table B.2 Number of spots for sampling incremental sample in huge amount (i.e. truck, barge, train wagon, warehouse)

Size of lot (tonnes)	Incremental sample (g)	Number of spots for incremental sample (spots)	Minimum sample for contaminant Analysis in laboratory (kg)	Minimum sample for other laboratory analysis (kg)
≤ 15	400-3,000	3	- Orchratoxin A and Aflatoxins : 10 - Pesticides, heavy metal and dioxins : 1 - Contaminants: 3	1- 3 According to specification for analysis
>15- 30		8		
>30-45		11		
>45-100		15		
>100-300		18		
>300-500		20		
>500-1,500		25		

The detail of instruction for sampling equipment or device, methods of analysis and method of reducing size of aggregate sample to obtain laboratory sample shall be in accordance with ISO 24333:2009 Cereals and cereal product-sampling.