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THE PARTICIPATORY PUBLIC POLICY FORMULATION OF CIVIL SOCIETY ON CHEMICAL USAGE REDUCTION IN AGRICULTURE: THE CASE OF NONG BUA LAMPHU, THAILAND

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ABSTRACT

Nong Bua Lamphu is a province located in the Northeastern region of Thailand which is ranked 76th in terms of overall income countrywide. In terms of agriculture, there is high usage of chemicals, leading to serious health problems such as the flesh-eating disease (necrotizing fasciitis) and cellulitis for farmers and consumers in the province. Provincial authorities have therefore implemented a reduction in chemical usage on a participatory basis. To do this, they formulated public policy to tackle the problem by teaming up with other governmental agencies, farmers, researchers, and the private sector involved in the policy-making process. This research underlines the way that public policy formulation and implementation had to rely upon the support of the stakeholders mentioned earlier. The major objective of this study is to formulate the participatory public policy of civil society in order to reduce chemical usage in agriculture. The study results suggest that three issues needed to be strategized: promoting recognition of organic agriculture, re-skilling in the organic agriculture sector, and support for organic agriculture and marketing. Moreover, this research also indicates that the farmers could employ additional techniques to help reduce the usage of chemicals such as the founding of voluntary communities and the establishment of a network for monitoring chemical usage. The study's authors are convinced that with the proper understanding, knowledge and techniques of organic agriculture, the farmers in Nong Bua Lamphu could reduce the usage of chemicals in agricultural production, thus enabling them to increase their income and enjoy a better life quality.

Keywords: Public policy; agricultural chemicals; civil society; participation; organic agriculture

1. INTRODUCTION

According to the Twelfth National Economic and Social Development Plan, and the integrated provincial development framework, Nong Bua Lamphu, a province located in the Northeastern part of Thailand approximately 518 kilometers away from the capital city, has formulated the four-year development strategies (2018-2021). The strategies include 1) life-long human resource development, 2) economic and social stabilization, 3) tourism-supported infrastructure and facility establishment, and 4) natural resource-environment reservation with the aim of attracting tourists, increasing people's quality of life, and managing society and the economy sustainably (Sudathip, 2019).

However, people in Nong Bua Lamphu are deeply concerned about the over-use of chemicals in agriculture especially in rice, sugarcane and rubber production, which has resulted in serious health issues for the farmers using them. Additionally, these concerns also extend to human resource development and natural resource protection in the province. A meeting was held on September 24, 2018 organized by the authority of Nong Bua Lamphu Province. Along with its governor, and other stakeholders from the public and private sectors, farmers and academics participated in the event. One of the agendas was to support and transform Nong Bua Lamphu into a city of organic agriculture through a research process. The initial study demonstrated that there were high levels of agricultural chemical contamination such as Paraquat, Chlorpyrifos, Atrazine, Ametryn and Glyphosate in sources of consumable fresh water and edible vegetables. The accumulated total was 24,936 liters. Moreover, each year, approximately 228 people suffered from the flesh-eating disease (necrotizing fasciitis), and 2,472 people suffered from cellulitis, which causes inflammation on people's skin.

This paper will suggest ways that could help Nong Bua Lamphu Province to fulfill its missions and respond to its vision through the implementation of public policy. The research aims to suggest public policy measures to reduce the use of agricultural chemicals by providing up-to-date information on current chemical use, demand for chemicals and opposition to their use, and the way to reduce chemical use. Even though the practices of farmers in Nong Bua Lamphu have to be changed to sustain natural resources and develop a better quality of life for inhabitants of the province, it is believed that the support of central government and the provincial authority through the form of public policy measures to reduce chemical use in agriculture will also be one of the keys to transform Nong Bua Lamphu.

2. PUBLIC POLICY FOR CHEMICAL USAGE REDUCTION IN AGRICULTURE

In accordance with the problem caused by chemical use in agriculture, the Nong Bua Lamphu authorities have emphasized the reduction of chemical use in agriculture, and prioritized it as one of the province's most important strategies. Despite applying several academic principles in the areas of agriculture, economics, marketing, and public health, public policy procedures are also considered to be important and necessary to set up goals, objectives and directions to reduce agricultural chemicals. For public policy, it provides the logical overview that could bind stakeholders and everyone involved in the issue to help each other towards the same goal at the same time that it represents a choice of action that government and its agencies decide and will implement (Bardach, 1978; Sidney, 2007).

To elaborate more on the public policy issue, there are policy characteristics and policy cycles that need to be emphasized. Sirisamphan (2003) suggests that there are three characteristics of policy:1) policy is a guideline for implementation; 2) policy can be in the form of plan, project or a course of actions; and 3) policy can lead the implementation towards goals and objectives. These three characteristics can be found in this study as a formulated policy that could be used as a guideline to reduce chemical use in agriculture. This can be combined with activities that could stimulate the transformation from chemical agriculture to organic agriculture, leading to the achievement of the study's objective. Furthermore, Tanapongsatorn (1987) also provides more in-depth details especially on the policy cycle in which he explained that in order to achieve expected objectives, goals, and benefits of organization, there are seven steps of policy cycle that need to be followed. Firstly, policy needs must be precisely determined. Secondly, preliminary consultation with stakeholders takes place to exchange ideas regarding the identified needs for policy. Thirdly, research must be conducted to find evidences to support each of the ideas that were raised in the previous step. Fourthly, the policy will be initially drafted and combined with a practical way of responding to objectives. Fifthly, stakeholders will consult on and revise the policy draft. The sixth step is to determine the policy and plan its implementation. Lastly, policy communication and implementation concerning the direction, the policy and the details will be made public to people and carried out. In relevance to this study that aims to reduce agricultural chemical use, the researchers have followed the steps proposed by Tanapongsatorn (1987) and reached the third step of the cycle as scheduled in the research plan where information on agricultural chemical use

including the current situation, emergent problems, and the opinion of stakeholders was gathered. Moreover, the researchers have also drafted the public policy for further policy determination and implementation.

In the similar mole of idea mentioned above, another scholar also suggests another way to understand public policy and its cycle, but in a broader perspective. Suksan (2002) suggests a broader idea on policy cycle in which there are three basic steps of the cycle. Firstly, the policy formulation process gathers all the information, details and policy options including the problems and also the affected people. Secondly, the policy determination process consists in policy goal setting, objectizing, drafting and choosing the most feasible policy. Lastly, policy implementation consists in policy legitimization, communication, implementation and evaluation. Thus, this study aims to formulate participatory public policy on the reduction of chemical use in agriculture by elaborating and further explaining the public policy process, especially at the policy formulation stage of agricultural chemical use reduction, which was the first step of the cycle proposed by Suksan (2002). Therefore, the researchers have decided to apply the seven-step policy cycle approach to this study and to identify the situation along with the result of the policymaking to make this study of more practical benefit to the stakeholders in Nong Bua Lamphu Province.

3. METHODOLOGY

The study on participatory public policy on the reduction of chemical use in agriculture for Nong Bua Lamphu used a purposive sampling technique by determining stakeholders affected by the agricultural chemical use in the province both at the policy level and implementation level including provincial authorities, officials, business owners, agricultural networks, and farmers. The total number of stakeholders was 60 persons, representing each sector of the province and participating in policymaking to reduce chemical use in agriculture.

As well as the research process for fulfilling the objective of obtaining participatory public policy on the reduction of chemical use in agriculture by civil society in Nong Bua Lamphu, the researchers studied related documents, information on the province, chemical use, development strategies, and ways to reduce chemical use to underline the benefits of a participatory public policymaking approach. Furthermore, in order to obtain data from the target groups, the researchers made observations, discussed with focus groups, and organized meetings with 60 stakeholders to participate in public policy drafting to reduce agricultural chemical use in Nong Bua Lamphu.

Moreover, the gathered data was categorized into groups as determined. Then the researchers employed content analysis techniques and synthesized the data to achieve an overview of each issue before processing all obtained data for the meeting with the stakeholders to draft public policy and understand how to reduce chemical use in agriculture. Finally, the researchers compiled the study results as structured to demonstrate the achievement of the research objective.

4. OVERALL SITUATION OF AGRICULTURAL CHEMICAL USE IN NONG BUA LAMPHU

Referring to the information from the meeting on September 24, 2018 organized by Nong Bua Lamphu's Public Health Office reported that several areas of the province are contaminated by agricultural chemical usage. According to the study of 460 samples including surface water, tap water, groundwater, soil, soil sediments, vegetables and fishes, the results showed:

1) The Paraquat contamination was found in the surface water, tap water and groundwater, while soil, soil sediments and vegetables were contaminated at a dangerous level. Moreover, low level of Paraquat contamination was found in fishes.
2) The Ametryn contamination was found at a high level in vegetables and fishes, and at a moderate level in soil and soil sediments, as well as at a safety level in surface water, tap water, and groundwater respectively.
3) The Atrazine contamination was found in fishes at a high level, in vegetables at a low level, and in surface water, tap water, ground water, soil, and soil sediments at a safety level.
4) The Glyphosate contamination was found in soil and soil sediments at a moderate level, in vegetables and fishes at a low level, and in surface water, tap water and ground water at a safety level.

Furthermore, the report also demonstrated that Nong Bua Lamphu's chemical usage in agriculture resulted in 228 people each year contracting the flesh-eating disease, and 2,472 people contracting cellulitis each year. It also caused skin disease, especially in males aged between 51 and 70 who worked in agriculture. Most of these people were admitted to hospital and reported that they were involved in activities involving

agricultural chemicals and sources of water. Chemical use mainly occurred in the production of sugarcane, rice, rubber and potatoes during the rainy season which lasts from May to September.

Moreover, the Nong Bua Lamphu authorities had established measures to deal with the situation. In order to reduce the use of agricultural chemicals, the public health agency had 1) established a volunteer group to increase awareness regarding the infection of the flesh-eating disease and the cellulitis caused by chemical usage in agriculture; 2) developed a medical system and database that is related to the agricultural chemical usage; and 3) standardized food safety. In addition, the authorities had coordinated with all related units in order to increase the efficiency of agricultural production and increase the potential and quality of agricultural products to meet established standards.

5. EFFECTS OF AGRICULTURAL CHEMICAL USAGE

Despite some effects on the farmers or people who used agricultural chemicals already mentioned in the previous section, there were also other effects of the chemicals used in agriculture. According to a previous study in Nan Province of Thailand, many people who are affected by the use of the chemicals in agriculture as demonstrated by medical tests carried out on the chemical users indicated that there was high accumulation of the substances inside the body that could cause brain damage and other symptoms as well (Kitana, 2019). Furthermore, the study on child development also suggested that there is a significant relationship between the accumulated quantity of agricultural chemicals in children's bodies and their development. The more chemicals found, the slower their development was, especially in terms of mental development. Furthermore, they are more prone to cancer (Kongtip, 2019).

People in Thailand were not the only ones that were affected by the use of chemicals in agriculture; people in other regions also faced the same issue. The use of some kinds and brands of agricultural chemicals has been limited, while some others were banned from use completely. For example, the lawsuit between the Monsanto Company and the herbicide users who used the company's product. The federal court of San Francisco came to the verdict that the company had to pay compensation to the chemical users because the company had not attempted to raise awareness or fully inform the users of the severe side-effects including cancer of using the chemicals (Sanook, 2019).

Moreover, in order to elaborate more, several giant agrochemical companies have decided not to support the sale of Paraquat and Glyphosate since 2007. One of the big companies selling agrochemicals was sued for more than 10,000 cases, and lost the case of selling Paraquat, and caused the damage on users (Thai-PAN, 2019). Therefore, the importance of reducing the use of agricultural chemicals has increased as well as people's awareness of the risks.

6. CHEMICAL USAGE REDUCTION IN AGRICULTURE: FEEDBACKS

The situation of the agrochemical issue has been spotlighted by many people in Thailand. The Prime Minister, Prayuth Chan-ocha, assigned the Ministry of Public Health back in January 2018 to investigate the related studies and effects of chemical usage especially Paraquat. From then up to the present, the Ministry and the Hazardous Substances Committee have studied and found that not only does use of Paraquat need to be limited, but also that Chlorpyrifos and Glyphosate should be banned eventually. The outcome has been to divide people into two groups, with one of them supporting the ban, and the other opposing it.

The results of this study demonstrate that the group of people who support the ban on agricultural chemical use, especially Paraquat, Chlorpyrifos, and Glyphosate, believe that the Government should have a policy and budget to support farmers who are using the substances while transitioning from chemical to organic agriculture. In addition, drawing from the ideas mentioned in the policy, the Government also should subsidize these farmers by integrating all related agencies and units to work on the issue together. Moreover, the government should promote organic agriculture for both farmers and consumers to reduce long-term use of agricultural chemicals.

In contrast, meetings with the other group of people produced the opposite results. This group of people oppose the ban of Paraquat, Chlorpyrifos and Glyphosate mentioned earlier. They believed that failure to use the three substances would cause underproduction in agriculture, which could lead to a lack of competitiveness in the global market. Furthermore, in regard to the ban, the Government has yet to legitimize and establish the operational plan. If this is not done, the farmers will be the ones who have to bear the burden of the increasing costs. Further, the Government itself will also have to compensate workers who are affected and laid off owing to the ban and cancelation of agrochemical production.

7. PARTICIPATORY PUBLIC POLICY FORMULATION TO REDUCE CHEMICAL USAGE

From all the above scenarios, the study's results suggest that it is critically important for the Government to find a middle ground for all stakeholders in order to reach an optimal solution since reducing agricultural chemical use is on the national agenda. A public policy is required that has to provide benefits for all and consider the needs of everyone involved in the issue. Thus, the participatory public policy formulation by civil society is the solution that this study would like to propose.

A public policy that would support the reduction of agrochemical use requires participation from farmers, civil society, governmental agencies, the private sector, and all those involved to help and formulate it. The policy should cover four categories: 1) compensation for farmers that have stocked the substances for their production; 2) support and facilitation to reduce agrochemical use; 3) the creation of sustainable agricultural areas; and 4) promotion of safe agricultural products for consumers.

Even though the policy has been formulated, its implementation is also in place. Nong Bua Lamphu Province's initial approach is exemplary in integrating provincial authority with other agencies, civil society, farmers, the private sector and academics as stakeholders in the area who know the context of the province well. Through the academic researching process, it should provide all-round information that is necessary for the authorities to provide proper knowledge for farmers concerning safety and organic agriculture. Moreover, the information could also be used to establish guidelines for the behavioral change that is essential to the policy for reducing agricultural chemical use. Initially, the province has planned to implement the whole process for a period of three years.

In order to convert the policy into implementation, the Nong Bua Lamphu authorities had to strategize three schemes. The first strategy is to increase the understanding of farmers regarding the importance of safety and organic agriculture; this could positively affect people's way of life in the long-run. Moreover, this strategy could reinforce the trend among people to consume more organic food, which will increase demand in the market as well. The second strategy is to transfer knowledge and training about organic agriculture. This knowledge could be derived from the local wisdom that the researchers systematically recompiled. Finally, the third strategy is to control the quality of products and to promote the sale of organic agricultural products. The introduction of testing techniques for contaminated substances is required to enable farmers to control the quality of their products during the transition from chemical to organic agriculture. What is more, raising the quality of organic products could lead to an increase in the value of product-related processes such as packaging, logistics, and online vendors in the future.

To be even more practical, the provincial authorities must put more emphasis on reducing agricultural chemical use. Beginning with school students, they should educate and implant the seeds of attitude change about the importance of organic agriculture. Moreover, areas for safe food production also need to be designated, and on top of that, the areas could be used as parts of the lessons for students so that they can learn more about water quality and contamination, soil quality and the agricultural products that are linked with the market that lies the end of the value chain.

Furthermore, another way in which the policy could help in reducing the use of agrochemicals is the promotion of safe integrated farming. Even though monoculture can provide a large number of agricultural products, it causes soil deterioration which could affect production in the long-run. A scheme to encourage farmers to understand and practice integrated or substituted farming is necessary, starting with soil fertilization by using biotic substances. In addition, farmers could also rotate their production by planting seasonal money-making crops.

Despite farming and agricultural production, the policy related to the community and human resource management on a participatory basis also has to be underlined. There is a need to establish and develop the voluntary community as a spearhead to monitor water and soil quality, to test the contamination level of chemical substances, and to transfer knowledge to other community members. For example, the organization of water and soil contamination testing with test kits could be done by trained volunteers.

Additionally, knowledge not only needs to be transferred, but also innovation that would improve community members' quality of life as well. The Government needs to support innovation that could enhance people's way of life through the policy. The development of charcoal kilns that could produce activated carbon, for example, is beneficial for the community since it could be used as a source of energy, and it has a positive effect in neutralizing Paraquat, one of the hazardous substances.

With all the details suggested above as parts of the public policy formulation for Nong Bua Lamphu, it is important and necessary to count on the participation of all stakeholders, especially the farmers in the province to become involved in the entire process (Jitpakdee et al., 2016). Thus, the provincial authorities have to act as a playmaker in coordinating with all the stakeholders to bring ideas and formulate a proper public policy that could benefit everyone, while achieving the goal of reducing the usage of agricultural chemicals at the same time.

8. PROGRESS ON PARTICIPATORY PUBLIC POLICY FORMULATION

The results of this study had proceeded to and reached at the first step as suggested by Suksan (2002) that there are three steps including the policy formulation, the policy determination, and the policy implementation. The results also suggested that Nong Bua Lamphu is almost the poorest province in Thailand since its gross income is ranked as 76th, and there is high usage of agricultural chemicals which have disrupted the life of farmers in terms of their health and livelihood. With respect to the objectives of this study, the aim of this research relates to changing the farmers' way of life by making the transition from the use of chemicals such as herbicides and pesticides to organic agriculture. More specifically, this public policy formulation process has reached only the third step out of seven in the policy cycle as suggested by Tanapongsatorn (1987), which will be further explained. For the first step of the policy formulation, the researchers had considered the situation of the high usage of chemicals in agriculture, leading to health problems for both farmers and consumers. The researchers also gathered related information by observing behavior and organizing meetings with groups of farmers in Nong Bua Lamphu where the information indicated high usage of chemicals in agriculture. As for the second step, the researchers raised the idea of organic agricultural production to the farmers; however, they tended to continue with their established practices using chemicals instead because of the lower costs compared to organic ones. Integrated or substituted farming was another idea proposed during the meetings; it was found that the farmers lacked knowledge of alternative plants for substitution. Then the third step of the policy cycle involved the researchers trying to gather more information and to use it to formulate public policy that could reduce th agricultural chemical usage in a sustainable, long-term way.

In the process of policy formulation for Nong Bua Lamphu, the researchers employed a backward-designed approach to propel the policy into implementation. In order to reduce chemical usage in agriculture, it is vital to design policy backwards because it provided a clear goal of the policy which could help to determine a more concrete course of actions (McTighe and Thomas, 2003). Furthermore, the participatory public policy formulation as a result of this study was aligned with the process that McTighe and Thomas (2003) had suggested and which could be summarized as follows.

Firstly, the study on market demand showed that farmers in Nong Bua Lamphu lacked knowledge of market mechanisms, present and future demands, and forecasting of agricultural product prices,which made it difficult for them to grow alternative plants for rotation. Moreover, the researchers also studied the outlets for agricultural products because the farmers do not understand consumer behavior or alternatives for product distribution. Here, the researchers needed to emphasize the importance of market-driven production which could lead to an increase in farmers' income and a reduction in agricultural chemical usage (Yu et al., 2017).

Secondly, as mentioned earlier, farmers in Nong Bua Lamphu were having trouble determining what kind of plants they should grow in order to transform from monoculture to an integrated farming system. Thus, the researchers decided to study and research again in order to indicate what kind of plants the farmers should grow. This research will connect with the goal of the public policy, and it could help in balancing soil quality at the same time (Reganold and Wachter, 2016).

Thirdly, when it came to reducing agrochemical usage, Nong Bua Lamphu's farmers were advised to switch from using chemicals including herbicides and pesticides to using biotic substances. However, it turned out that the bitoic substances were not suitable and were less effective compared to chemicals. So, the researchers had to study and develop biotic substances that could meet the needs of the farmers for soil preparation, agricultural production, and plant protection effectively (Rao et al., 2015).

Fourthly, with respect to the first summary, one of the concerns over the reduction of agricultural chemical usage among Nong Bua Lamphu's farmers was loss of income; they believed that organic agricultural methods cost them more compared to using chemicals. Therefore, the researchers had to design a business model and present it to the farmers to indicate a way to increase their income through organic agriculture production; in addition, it could attract more young smart farmers who had migrated away to return and work towards this public policy's goals (Hamilton et al., 2015; Jitpakdee et al., 2017).

In addition, another key factor that affected the participatory public policy formulation by civil society on chemical use reducton in agriculture in Non Bua Lamphu Province was that of continuity. At the beginning, the policy was initiated by the former governor in collaboration with the leaders of government agencies along with civil society, farmers, researchers and the private sector. The policy formulation process had been undergoing implementation for months with each research team working with farmers in the province. However, the situation changed when the new governor assumed his position without any knowledge of the ongoing policy, which resulted in a lack of progress in formulating the policy. Therefore, the researchers found that constant and continual communication with the governor and other stakeholders was the key to keeping the public policy formulation progressing.

9. DISCUSSION

In order to formulate the public policy for chemical usage reduction in agriculture on a participatory basis, Nong Bua Lamphu authorities need to consider several issues. The first issue was that all stakeholders including the public and private sectors, farmers and academics were required to provide relevant information and opinion concerning public policy formulation, as suggested by the work of Jitpakdee et al. (2016), who stressed that the success of the policy and management depended upon the participation of the stakeholders. Furthermore, as already mentioned in the previous section, the public policy achieved by this study was formulated with the backward design approach. In order to formulate public policy by considering the production line at the end, agricultural products will be sold in the market which is related to consumer demand. According to the Thai Health Promotion Foundation (2014), the demand for organic or safe food has been increasing significantly for the past decade as Thai people have focused more on their health. With this demand, it is undeniable that the farmers of Nong Bua Lamphu have a good economic opportunity by making the transition from chemical to organic agriculture as supported by the results of the study by Willer et al. (2019).

However, some of the farmers in Nong Bua Lamphu found difficulties when practising organic agriculture due to their limited knowledge of market mechanisms and organic alternatives in agriculture. The farmers in Nong Bua Lamphu need better understanding of organic agriculture, alternatives that can enable them to reduce agrochemical usage, and knowledge that could assist them in the transition period. In that case, Wojciechowska-Solis and Soroka (2017) proposed that the process of providing knowledge and training to increase farmers' understanding of organic and alternative agriculture, technology and marketing as one of the strategies of public policy needs to be organized for the farmers who were involved in this study. Moreover, the study's results also suggested that the farmers of Nong Bua Lamphu had a positive perception regarding the reduction of agricultural chemical use, but that there were some limitations as organic agriculture required a higher budget, and consumed more time compared to chemical-based agriculture. This caused a dilemma for the farmers similar to the ones studied by Janjhua et al. (2019).

Most importantly, the continuity of support by the public authorities had to be spotlighted and discussed. The results of this research demonstrated that the success rate of the participatory public policy formulation by civil society to reduce chemical usage in agriculture depended upon the continuing support of the authorities, especially the governor in the case of Nong Bua Lamphu. According to the provincial governing system in Thailand, the governor of each province will be rotated to another province after one to four years. With such a rotation system, continuity of public policy — especially in terms of policy determination and implementation at the provincial level — could be affected as it might be changed if the new governor has a different point of view. This reflects the study results of McDougall (2020) that also emphasized the issue of continuity. Thus, from all the above discussion, formulation of the participatory public policy of civil society to reduce agrochemical usage in Nong Bua Lamphu by all related stakeholders could be considered as a social movement that required time and continuity to be successful.

10. CONCLUSION

The situation of agricultural chemical usage in the context of Nong Bua Lamphu had become severe since farmers in the province were suffering serious health problems. Each year, flesh-eating disease (necrotizing fasciitis) and cellulitis occurred from the usage of agrochemicals led to negative effects among more than 200 people. The need for a change in agricultural production which served as the impetus for the transition process was required and spearheaded by the Nong Bua Lamphu authorities led by its governor along with the public and private sectors, farmers and academics who, altogether, may be considered civil society. The public policy formulation process began with the stakeholder determination, and was followed by related data researching, on-site observation, and the organization of meetings with the purposes of raising awareness of the negative effects of agricultural chemical usage, increasing understanding of the importance of reducing agrochemical usage, and proposing preliminary guidelines for all stakeholders' consideration. Once the proposed guidelines were mutually agreed, the participatory public policy of civil society on chemical usage reduction in agriculture could be drafted, and it became the outcome of the overall process of policy formulation. This outcome, if this public policy turns out to be successful in reducing agrochemical usage, could be used as a model for other provinces that encounter the same problem.

11. RECOMMENDATION

According to the study's results, the following recommendations need to be emphasized to facilitate successful participatory public policy formulation by civil society on chemical usage reduction in agriculture in Nong Bua Lamphu Province:

1) The public policy formulation need support from the central government, the provincial authorities and other stakeholders in terms of policy making, budgeting, and reducing the use of agricultural chemicals.

2) The policy making committee and the research taskforce had to be established to study the problem and the current situation to tackle the over-use of agrochemicals, to encourage farmers to switch to organic agriculture, and to increase the value of organic agricultural products.

3) Three strategies had to be taken into account: increasing farmers' understanding of organic agriculture, sharing knowledge on practices and techniques of organic agriculture, and controlling agricultural product quality, economics, and marketing.

4) The role of provincial authorities and governmental agencies in supporting and facilitating a reduction in chemical usage in agriculture had to be increased, and at the same time, farmers also had to learn more about and practice organic agricultural methods.

If all of these recommendations were implemented, chemical usage in agriculture in Nong Bua Lamphu would be reduced, and it could lead the province to achieve a sustainable state, to live up to its 'city of life' title, and to enjoy a higher quality of life.

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