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Trials on the Environmental Education Processes as Reducing Cholinesterase Enzyme in Blood and Residues of Chemicals in Soil with sugarcane farmers in Phetchabun Province of Thailand

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Abstract

This study was quasi- experimental research, and the objectives were to i) study behavior in practice for self- prevention in chemicals use before and after using environmental education processes, ii) compare cholinesterase enzyme in blood of sugarcane farmers before and after using environmental education processes, and iii) compare amount of chemical residues in soil in the sugarcane planting areas before and after using environmental education processes. The sample were the 36 sugarcane farmers whom had cholinesterase enzyme in blood equal to or more than risk level, and were selected by multi-stage sampling. Of these test kit used for the analysis of cholinesterase enzyme in blood with the reactive paper of the Department of Health (1997) and chemical residues in soil based on the standard of the Department of Health (1997) by the method of High-Performance Liquid Chromatography (HPLC) with the unit of mg/kg and reported according to the central laboratory.

The comparisons of the behavior in practice for self-prevention in chemicals use revealed that after using environmental education processes, mean higher than before with a statistical significance level of 0.01. The comparisons of cholinesterase enzyme in blood of sugarcane farmers revealed that before trials, the most of them had a cholinesterase enzyme level at risk equal to 27 persons or 75.00 %, but after trials they were at a risk equal to 18 persons or 50.00 % which it was lower than before. The sample soil for the analysis of chemicals residues revealed that before trials found the organophosphate 72.15 mg/kg, carbamate 10.00 mg/kg, glyphosate 9.99 mg/kg, and paraquat 5.21 mg/kg which it was at an unsafe level, but after trials found that the organophosphate, carbamate, glyphosate, and paraquat, were at a safe level or not detected.

Keywords: Environmental Education Processes, Chemicals, Farmers.

Introduction

C The rapid economic and social change affected the leaping development and so that convenient products were processing for human by depended on science and technology. The agriculture sector needed to increase foods products to respond the human foods, causing the higher economic competition. Chemicals were used to activate the plants to be growth, lure to consume, no clue of eating by any animals and insects. These reasons attracted the farmers proliferate used chemicals. (Veeravatnanond, V. , 2010).

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Thailand is the agricultural country for a long time since ancestors because the geography and climate that properly for plantation.

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The most of people were the farmers and they chosen to use chemicals proliferate every all steps of plantations, so called the chemical agriculture cycle and they expected that increasing agricultural products. (Agricultural Economic Bureau, 2011). The data of imported chemicals since 2014-2017 showed that herbicides imported in average 512,191 kilograms per year, insecticide in average 64,494 kilograms per year, fungicide in average 54,914 kilograms per year. Because Thailand could not produce chemicals, so it imported raw material or substances for sell or mixed for sell (Agricultural Economic Bureau, Department of Agriculture, 2017).

Phetchabun province administered 11 districts with the area of 7,917,760 rai, agricultural areas 3,199,759 rai, they are farmers 199,533 households or 698,132 farmers. There were the monoculture cash crop which used chemicals all areas of province. The registered farmers who grew sugarcane found that 4 districts as following: Wichian Buri district equal to 3,169 farmers with the area 81,918 rai, Si Thep district equal to 3,187 farmers with the area 68,190 rai, Bung Sam Phan district equal to 1,249 farmers with the area 29,032 rai, and Nong Phai district equal to 552 farmers with the area 11,695 rai (registration of sugarcane farmers, Phetchabun province, 2017). The plantation comprising rice, garden crops, and field crops but sugarcane is the most use of chemicals not only by volume but also by concentration (Agricultural Economic Bureau, 2017).

The most people in Si Thep district were the farmers which they grew sugarcane, rice, corn, tapioca. All of plants used chemicals when they started to grow. While 90 percent of chemicals were oraganophosphate, carbamate, neonicotinoid which were absorptive. These chemicals have a special property to permeate into trunk, capable to destroy insects from hazardous substances. The surveillance reports on chemicals by Si Thep District Public Health Office in 2017 revealed that there were 703 farmers who used chemicals have a level of cholinesterase enzyme in blood and 438 farmers were at a risk level, 102 farmers were at unsafe level (Si Thep District Public Health Office, 2018). From the quoted data showed that sugarcane farmers in Si Thep district used chemicals very much and the surveillance reports on chemicals showed that they were at a risk more than other areas.

The problems which were caused by chemicals use may affected health and environment. The impacts on health; divided into 2 parts as follows: impacts on acute hazardous; farmers may be have symptoms immediately when they contacted with chemicals such as squeamish, vomit, headache, muscle pain, diarrhea, shortness of breath, blurred vision. Impacts on chronic; caused by accumulated toxic chemicals and caused diseases and health problems such as cancer, diabetes, paralysis, skin diseases, barren, paralysis of newborn, and sexual dysfunctions (Department of Disease Control, Ministry of Public Health, 2008). The impacts on environment; deteriorating the quality of critical ecosystem in environment such as soil deterioration, reducing of ground cover plants, air pollution, and water contaminated with chemicals caused the death of aquatic animals and damaging effect on ecosystem. (Wasee, P. , 2004).

The approaches to solve this problems were reducing chemicals use or used appropriately, need to promote farmers to have knowledge and understanding, having good values, awareness of impacts that may be effect on health and skills in using chemicals without destroying environment to be unbalance. The area of Si Thep district, there were not to solve concretely on this problems, merely the public health officials trained for knowledge and promoted to reduce chemicals use without monitored or evaluated continually. The surveillance results and checked annually a level of cholinesterase enzyme in blood of farmers who used chemicals revealed the most of them were at a risk (Si Thep District Public Health Office, 2018). The problems solving to reduce chemicals use needed to find out new approach that focused on participation. This approach were gathering body of knowledge, experiences of relevance sectors comprising public sector, agriculture sector which were chemicals use, industrial sector, and chemicals sellers. These data were analyzed, synthesized and drafted a proper model and applied to practices. So as sustainable reducing chemicals use, reducing the impacts on health and environment. (Department of Environmental Quality Promotion, 2005).

The significance of chemicals use problems by sugarcane farmers affected the impacts on farmers' health who used chemicals and environments which were contaminated by chemical residues in soil as well as degradation of ecosystem. The researcher interested in the environmental education processes in order to create proper behaviors according to context of each area so as reducing chemicals use and finally for the safety of farmers on health and environment especially chemical residues in soil. The environmental education processes activated farmers in their communities to learn and aware any problems belonging to local conditions and conduced to reduce chemicals use, reducing cholinesterase enzyme and chemical residues in soil.

Materials and Methods

The objectives of research

1. Study behavior in practice for self- prevention in chemicals use before and after using environmental education processes.

2. Compare cholinesterase enzyme in blood of sugarcane farmers before and after using environmental education processes.

3. Compare amount of chemical residues in soil in the sugarcane planting areas before and after using environmental education processes.

Research Methodology

This study was designed as a quasi- experimental research

with a types of One- group pre-test – post-test design as shown in figure 1

Experimental Group	O_1	X	O_2

Figure 1: model of research

symbols of this research

O1 = is a pre-test measures or observed before intervention composted of the level of behavior in practice, level of cholinesterase enzyme in blood, and amount of chemical residues in soil

X = treatment or intervention with the environmental education processes

O2 = is a post-test measures or observed after intervention composted of the level of behavior in practice, level of cholinesterase enzyme in blood, and amount of chemical residues in soil

Conceptual Framework

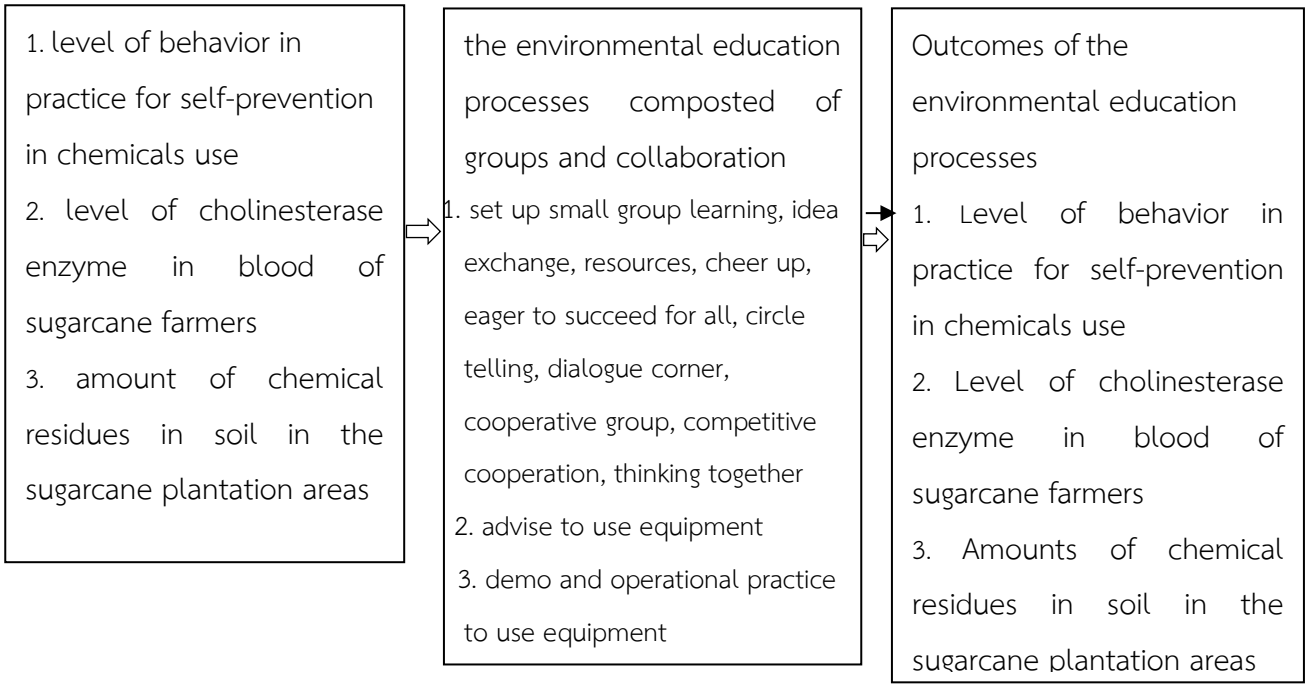


Figure 2: Conceptual Framework

Population and Sample

1. The population were the 341 sugarcane farmers registered and using chemicals in Si Thep district. (data from Registered Records, Si Thep district, Phetchabun province, 2017)

2. The sample size was determined by statistical program and find out a Power of the test G*Power (Buchner, 2010) (e=0.5, power of test =0.60 (Phaiphad, N. ,2014), totally 36 persons and selected by multi-stage sampling and purposive sampling from the farmers who had a level of cholinesterase enzyme in blood equal to or more than risk level (≥75.0 mg/l).

Research tools

1. Questionnaires to measure behavior in practice for self-prevention in chemicals use (Wiratchai 2021).

2. The instrument to analyze cholinesterase enzyme in blood was a cholinesterase enzyme test kit with the reactive paper of Department of Health (1997).

3. The equipment used to collect sample soil so as the analysis of chemical residues composted of shovel, plastic bags, plastic cans, and analysis based on the standard criteria of Department of Health (1997) by the method of High Performance Liquid Chromatography (HPLC) to seek amounts of chemical residues, then reported with the report form of central laboratory in a unit of mg/kg.

Verifying quality of tools

A questionnaires were validated with the item-objective congruence or IOC = 0.80, and reliability level of 0.92. Statistics were used to analyzed data comprising frequencies, percentage, mean, and standard deviation, analyzed cholinesterase enzyme in blood by cholinesterase enzyme test kit with the reactive paper of Department of Health (1997), analyzed chemical residues in soil based on the standard criteria of Department of Health (1997) by the method of High Performance Liquid Chromatography (HPLC) to seek amounts of chemical residues, then reported with the report form of central laboratory in a unit of mg/kg.

Methods of data gathering

Before intervention

1. Studied and collected data by using questionnaires on behavior in practice for self-prevention from chemicals use.

2. The officials of laboratory and professional nurse of Si

Thep hospital, Si Thep district, Phetchabun province collected a sample of blood at fingertips for 1 ml and analyzed cholinesterase enzyme in blood by cholinesterase enzyme test kit with the reactive paper of Department of Health (1997).

3. Collected the sample of soil by simple random sampling from 5-10 land points, In each sample must be collect from different points, in each sample of soil at a land point collected 3 land plots at depth level 2 were 0-10 cm. and 10-20 cm. The sample of soil collected from 4 points of each land plot, totally 36 land plots, then mixed together and becoming a sample of land plot, the sample of soil contained in plastic bags and wrote number and named of sample sent to analyze at central laboratory (Chanprab, C. et al. 2017).

After intervention

1. Using questionnaires to evaluate and follow up behaviors in practice for self-prevention in chemicals use after intervention 1 month.

2. The officials of laboratory and professional nurse of Si Thep hospital, Si Thep district, Phetchabun province collected a sample of blood at fingertips for 1 ml and analyzed cholinesterase enzyme in blood by cholinesterase enzyme test kit with the reactive paper of Department of Health (1997).

3. Collected the sample of soil by simple random sampling from 5-10 land points, In each sample must be collect from different points, in each sample of soil at a land point collected 3 land plots at depth level 2 were 0-10 cm. and 10-20 cm. The sample of soil collected from 4 points of each land plot, totally 36 land plots, then mixed together and becoming a sample of land plot, the sample of soil contained in plastic bag and wrote number and named of sample sent to analyze at central laboratory (Chanprab, C. et al. 2017).

Statistics and the analysis of data

1. Statistics were used to analyzed data comprising frequencies, percentage, mean, and standard deviation. .

2. Analyzed cholinesterase enzyme in blood by cholinesterase enzyme test kit with the reactive paper of Department of Health (1997).

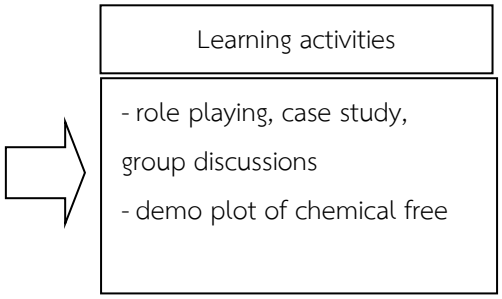
3. Analyzed chemical residues in soil based on the standard criteria of Department of Health (1997) by the method of High Performance Liquid Chromatography (HPLC) to seek amounts of chemical residues, then reported with the report form of central laboratory in a unit of mg/kg.

Results

Research findings

1. Using environmental education processes to create learning for self-prevention in chemicals use.

1.1 group process



1.2 cooperative process

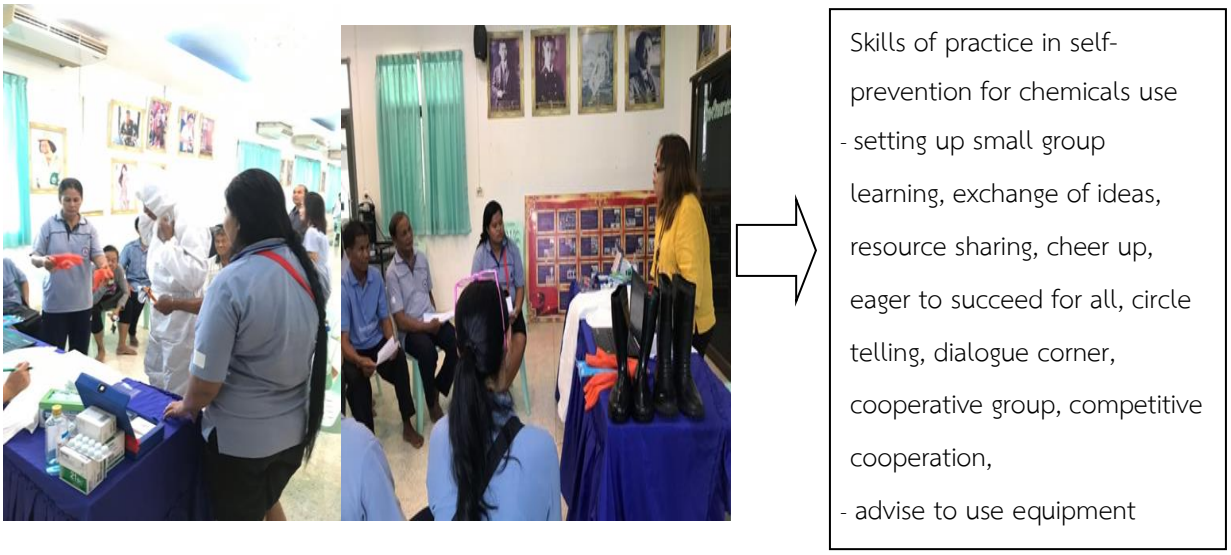


Figure 3: using environmental education processes with group process, cooperative process, and learning activities

2. Outcomes of behavior in practice for self-prevention in chemicals use of sugarcane farmers using environmental education processes.

Table 1: compared mean of behavior in practice for self-prevention in chemicals use of sugarcane farmers before and after using environmental education processes

Factors	n	$\bar{X}$	S.D.	t	df	P-value
Behavior in practice in self-prevention for chemicals use						
Pre-test	36	42.05	2.99	10.583	35	<0.000
Post-test	36	44.72	2.88			

*p<.01

From table 1 showed the outcomes of behavior in practice for self-prevention in chemicals use of sugarcane farmers before and after using environmental education processes revealed that after trials they had mean higher than before at a statistical significance level of 0.01.

3. The level of cholinesterase enzyme in blood of sugarcane farmers before and after using environmental education processes.

Table 2: compared the level of cholinesterase enzyme in blood of sugarcane farmers before and after using environmental education processes.

level of cholinesterase enzyme	before		after	
	Number of persons	percentage	Number of persons	percentage
normal (≥100 mg/l)	-	-	2	5.60
safe (≥87.5 mg/l)	-	-	16	44.44
risk (≥75.0 mg/l)	27	75.00	18	50.00
unsafe (>75.0 mg/l)	9	25.60	-	-

From table 2 showed the comparisons of the level of cholinesterase enzyme in blood of sugarcane farmers before and after using environmental education processes revealed that the farmers who has a level at risk decreased from 27 persons to 18 persons or 50.00 % after trials.

4. The comparisons of chemical residues in soil in the sugarcane plantation areas of farmers before and after using environmental education processes showed in table 3.

Table 3: comparing chemical residues in soil in the sugarcane plantation areas of farmers before and after using environmental education processes

Chemicals Group	before			after		
	amount	unit	level	amount	unit	level
Organophosphate Group	72.15	mg/kg	unsafe	Not Detected	mg/kg	safe
Carbamate Group	10.00	mg/kg	unsafe	Not Detected	mg/kg	safe
Glyphosate Group	9.99	mg/kg	unsafe	Not Detected	mg/kg	safe
Paraquat Group	5.21	mg/kg	unsafe	Not Detected	mg/kg	safe

From table 3 showed the amount and level of chemical residues in soil in the sugarcane plantation areas of farmers before and after using environmental education processes revealed that before trials chemicals group were found as follows; organophosphate group = 72.15 mg/kg, carbamate group = 10.00 mg/kg, glyphosate group = 9.99 mg/kg, and paraquat group = 5.21 mg/kg which were at an unsafe level but after trials all of chemicals group were at a safe level (not detected).

Discussions

The outcomes of behavior in practice for self-prevention in chemicals use of sugarcane farmers using environmental education processes revealed that after trials they had mean more than before trials at a statistical significance level of 0.01 (t= 10.583, p=0.000). It may be due to trials on environmental education processes focused on participatory learning, cooperative learning, lecturers set the important of equipment for self-prevention in the chemicals use and reducing the impacts on health, advised to use equipment for various chemicals and studied labels that identified concentration of each chemicals, demonstrated method to use equipment for each chemicals, the farmers discussed together and exchange their idea within group and learning by experience to use equipment for self-prevention in chemicals use which was consistent with Suthiprapa, T. (2007). Who studied the participatory learning process to reduce the impact on health and the environment from the use of chemicals and changing behaviour in chemical use and found that after using the participatory learning process and the farmers shared idea and group discussions together affecting behavior in chemicals use and had not found chemicals residues in soil and Acacia pennata. The residues in blood of farmers after treatment for 3 months reduced from before or just finished treatment at a statistical significance level of 0.05. So that this participatory learning process affected behavior of farmers who grew Acacia pennata to use chemicals more proper and more durable, finally they were able to reduce chemicals residues in blood and environment.

The comparisons of the level of cholinesterase enzyme in blood of sugarcane farmers revealed that after using environmental education processes the farmers who has a level at risk decreased from 27 persons to 18 persons or 50.00 % after trials. Moreover, the researcher followed up and evaluated behavior in practice for self-prevention in chemicals use found that they were at the highest level which it meant the farmers practiced continually so as reducing level of cholinesterase enzyme in blood. The environmental education processes focused on participative operational learning process and each learning process emphasized on self-learning, practiced, demonstrated and doing by themselves. They have been learned, memorized, and applied and finally it was helpful to have a good health which was consistent with Phaiphad, N. (2014), who studied model of participatory learning of rice farmers using pesticides for behavioral change to reduce impacts on health and environment, Rong Kham district, Kalasin province, revealed that after using model of participatory learning of rice farmers using pesticides, the level of cholinesterase enzyme in blood reduced from 58.00 % to 26.00 % and 4.00 % at a statistical significance level of 0.05. Moreover it was consistent with Suthiprapa, T. (2007), who studied the participatory learning process to reduce the impact on health and the environment from the use of chemicals and changing behaviour in chemical use revealed that after trials 3 months, no found chemical residues in blood and reduced from before and after trials at a statistical significance level of 0.05

The comparative results of amount and level of chemical residues in soil in the sugarcane plantation areas of farmers before and after using environmental education processes which were collected soil by method of High Performance Liquid Chromatography (HPLC) revealed that after trials the chemical residues in soil were reduced such as organophosphate group, carbamate group, glyphosate group, and paraquat group. It may be due to trials on environmental education processes focused on participatory learning, cooperative learning, each learning process focused on self-learning, doing by practice, and applied continually so as reducing chemicals use which was consistent with Suthiprapa, T. (2007). Who studied the participatory learning process to reduce the impacts on health and the environment from the use of chemicals and changing behavior in chemical use and found that after the farmers shared idea and group discussions together had not found chemicals residues in soil and Acacia pennata. And it was consistent with Phaiphad, N. (2014), who studied model of participatory learning of rice farmers using pesticides for behavioral change to reduce impacts on health and environment, Rong Kham district, Kalasin province, revealed that after using model of participatory learning of rice farmers had no found chemical residues at a statistical significance level of 0.05.

Conclusions

The comparative outcomes of behavior in practice for self-prevention in chemicals use after using environmental education processes showed that they had mean more than before trials at a statistical significance level of 0.01. The comparative outcomes of the level of cholinesterase enzyme in blood of sugarcane farmers revealed that after using environmental education processes the farmers who has a level at risk decreased from 27 persons to 18 persons or 50.00 % after trials. The amount and level of chemical residues in soil in the sugarcane plantation areas of farmers before and after using environmental education processes revealed that before trials chemicals group were found as follows; organophosphate group = 72.15 mg/kg, carbamate group = 10.00 mg/kg, glyphosate group = 9.99 mg/kg, and paraquat group = 5.21 mg/kg which were at an unsafe level but after trials all of chemicals group were at a safe level (not

detected). These results due to using environmental education processes enhanced behavior in practice as reducing chemicals use and to self-prevention for chemicals use accurately, mitigating impacts on health and environment and finally they have been good quality of life and sustainable environment.

Suggestions

1.The public health agencies should carry out environmental education processes for the extension of other group of farmers in Phetchabun province and vicinity in order to reduce chemicals use and helpful to use safety.

2.The agricultural agencies should set up policy level to promote farmers having knowledge, aware of dangerous chemicals and support organic agriculture, eco-agriculture or safety agriculture and emphasized on biological substances.

Suggestions for further research

1.It should study on the research title of eco-agriculture development within farmers of Si Thep district, Phetchabun province as avoidance chemicals use in order to safe for health and environment.

2.It should study on the organic agriculture learning center base on the philosophy of sufficiency economy principle in Phetchabun province as the prototype for other groups.

Acknowledgements

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Ethical Clearance

Researcher requested letter of consent from human research ethics committee, Research Division, Mahasarakham University, Thailand, No. อว. 0605.1 (9)/2685, effective date 20 November 2019, No. of certified 203/2019.

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