PROCEEDINGS

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24TH FEBRUARY, 2022

ONLINE CONFERENCE



HUNGARIAN TIED AID LOAN FOR LAOS
Development of the food chain safety system in the Lao P.D.R

Hungary – Lao PDR
2022

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Preface

Ladies and Gentlemen,

I welcome you on the occasion of the 1st International Conference on Agricultural and Food Chain Safety Development, to be held online, in 2022.

The improvement of safe food supply is a long-term program in Laos, that requires further institutional strengthening and human resources development beyond the time frame of the Hungarian tied aid loan program. As aim of the program, human resources development includes, among others, national and international conference organization and participation and development of international relations. These are the goals that we would like to achieve with this conference.

On 3rd November, 2021 Hungarian-Lao Joint Scientific Committee held its first organizing committee online workshop, where the participants introduced themselves. We reviewed the conference call and we agreed on the major topics of the conference. Also, the date and time of the conference was accepted that time.

The Hungarian-Lao Joint Scientific Committee's mission is to promote activities that help to acquire and advance knowledge in the field of agriculture.

The main organisers are colleagues from National University of Laos and Hungarian University of Agriculture and Life Sciences.

Since its foundation, National University of Laos has a clear vision to be not merely the leading university of the country, but also to be recognized in the region as well as in the world. Hence The vision of is set to become the center of excellence for higher education studies, research and cultural preservation, strengthening capacity building and human resources development with intellectual vitality, potential knowledge and skills, good attitudes, loyalty, dignity, and good health. The mission of the National University of Laos is to meet the development needs of Laos in a suitable, efficient and equitable manner.

Hungarian University of Agriculture and Life Sciences is one of Central Europe's most prominent institutions of higher education in agricultural sciences, agricultural machinery and theory of land locomotion. The University has 20 different institutes for study and research and hosts approximately 16.000 students.

I wish you a successful conference!

Dr. László Máthé
Conference Secretary

About the Conference

The 1st International Conference on Agricultural and Food Chain Safety Development was organized by Hungarian University of Agriculture and Life Sciences and National University of Laos and the Hungarian-Lao Joint Scientific Committee.

The background of the conference is the third Hungarian tied aid loan project in Laos, entitled "Agricultural Infrastructure Development", which aims to strengthen and consolidate the Lao food chain safety system. The program also includes complex activities to help small farms in seven provinces in central and northern Laos to use modern technologies and methods in the field of cattle and fish farming and meat and fish processing and marketing. The program aims to develop the entire product value chain and will help to bring high-quality meat and fish products to the market that meet food safety requirements, will furthermore help to improve the livelihood of small rural businesses.

The Hungarian University of Agriculture and Life Sciences (MATE) is closely involved in the project, not only through researchers, experts and specialists, but also in the field of education, in which the two parties develop joint trainings. The aim of the conference is to present the results of the Hungarian-Lao project on an international scale, as well as to learn about good practices from experts in other countries.

This conference is being organized for the first time, however, the organizers would like to repeat the event every year. For the time being, due to the COVID pandemic, the event will be held online or in a hybrid format.

Technical tracks are listed below for paper submission:

- Track 1.: Pedology (modern observation tools, mapping, information systems, environmental relations)
- Track 2.: Crop production (cultivation, plant protection, organic production, environmental relations)
- Track 3.: Agricultural water management
- Track 4.: Animal science (animal production, animal breeding, animal health)
- Track 5.: Fisheries and aquaculture
- Track 6.: Post-harvest technologies
- Track 7.: Food chain safety system development

All papers are peer-reviewed.

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Conference Programme

https://uni-mate.hu/esemény/-/content-viewer/1st-international-conference-on-agricultural-and-food-chain-development/20123

24 February, 2022					
8:00 (GMT+1) 14:00 (GMT+7)	Welcome speech	Dr. Laszlo Mathe	Conference Secretary	Hungarian University of Agriculture and Life Sciences	Hungary
8:05 (GMT+1) 14:05 (GMT+7)	Opening speech	Dr. Vannaphone Putthana	Conference Chair	National University of Laos	Laos
8:15 (GMT+1) 14:15 (GMT+7)	Opening speech	Dr. Laszlo Varadi	Conference Co-Chair	Vitafort Agro Asia Co.	Hungary
8:30 (GMT+1) 14:30 (GMT+7)	Value chain analysis of the fisheries and aquaculture sector in Laos to contribute to the improvement of food security and food safety	Emese Bekefi, Vannaphar Tammajedy, Laszlo Varadi	MATE-Vitafort Agro Asia - DLF	MATE-Vitafort Agro Asia - DLF	Laos, Hungary
8:45 (GMT+1) 14:45 (GMT+7)	Results of testing Hungarian varieties in the soil and climatic conditions of the Republic of Uzbekistan	Mrs. Mukhtabar Tashmatova	Director of the Uzbek-Hungarian Scientific Center for Potato Growing	Research Institute of Vegetable, Melon crops and Potato	Uzbekistan
9:00 (GMT+1) 15:00 (GMT+7)	Assessment of sustainable coffee value chain in the North mountainous areas of Laos	Dr. Sayvisene Boulom	Deputy Head of Rural Economics and Food Technology Department	National University of Laos	Laos
9:15 (GMT+1) 15:15 (GMT+7)	Perception of community garden leaders towards environmental concern and food safety during the pandemic	Pn. Aimi Athirah Binti Ahmad	Senior Researcher Officer of Socio Economy, Market Intelligence & Agribusiness Research Center	Malaysia Agricultural Research and Development Institute	Malaysia
9:30 (GMT+1) 15:30 (GMT+7)	Nutritional status of Turkey berry (Solanum torvum Sw.) powder as influenced by three drying methods for commercial production	Prof.Charles Tortoe	Acting Director	CSIR-Food Research Institute, Ghana	Ghana
9:45 (GMT+1) 15:45 (GMT+7)	Watermelon production and pest managements in Laungnamtha Province, Lao PDR	Dr. Phoutthasone Sibounnavong	Vice Head of Agronomy Department	National University of Laos	Laos

10:00 (GMT+1) 16:00 (GMT+7)	Redox potential as an alternative method for quantification and differentiation of microbes	Eya Yakdhane	PhD student	Hungarian University of Agriculture and Life Sciences	Hungary, Tunis
10:15 (GMT+1) 16:15 (GMT+7)	Evaluation of Pork Standard and Quality from CP Laos at Done Dou Slaughterhouse in Vientiane Capital	Yanglao Yialee	Lecturer/researcher	National University of Laos	Laos
10:30 (GMT+1) 16:30 (GMT+7)	Impacted of COVID-19 on Aquaculture Production in Lao PDR	Dr. Phouvin Phousavanh	Head of Livestock and Fishery Department	National University of Laos	Laos
10:45 (GMT+1) 16:45 (GMT+7)	Environmental impact of pesticide use from banana plantation in Laos	Mr. Souliya Souvanduan	PhD Student	Khonkae University, Thailand	Thailand, Laos
11:00 (GMT+1) 17:00 (GMT+7)	Closing remarks	Dr. Laszlo Mathe	Conference Secretary	Hungarian University of Agriculture and Life Sciences	Hungary

List of Participants

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VALUE CHAIN ANALYSIS OF THE FISHERIES AND AQUACULTURE SECTOR IN THE LAO PDR TO CONTRIBUTE TO THE IMPROVEMENT OF FOOD SECURITY AND FOOD SAFETY

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Abstract

Fish is a salient animal protein supply to the people in the Lao PDR. Fisheries and aquaculture have been traditional activities that are based on the utilization of the rich aquatic resources of the country. The sector however is facing great challenges such as increasing needs for sustainable use of resources, changing socio-economic conditions, and climate change. There have been efforts to increase sustainable production of fish and improve the quality and safety of fish products by the government and donors including the Hungarian government, however no systematic analysis has been made so far in the fisheries and aquaculture sector. In the frame of the 3rd Hungarian agricultural tied aid loan program, one of the key activities of the Fisheries and Aquaculture component is the execution of a Value Chain Analysis (VCA). Based on the findings and recommendations of the VCA an action plan will be elaborated that will contribute to the implementation of other key activities of the tied aid loan project such as the production and processing of high quality and safe fish products.

Keywords: Value Chain Analysis, fisheries and aquaculture, food safety and food security, Hungarian tied aid loan program, Lao PDR

1. Aquaculture in the Lao PDR

In the Lao PDR, the agricultural sector (crop production, aquaculture and fisheries, animal husbandry, and forestry) is one of the main pillars of the national economy. About 71% of the employed work in the agricultural sector, mainly on small family farms. 48% of GDP (the second fastest growing GDP in the region after China) comes from agriculture and the exploitation of natural resources. The sustainable use of natural resources is therefore of strategic importance to the Lao PDR that has abundant aquatic resources for fisheries and aquaculture (Bozánné Bekefi et al., 2021). Aquaculture and fisheries play important role in providing employment and protein to the population. The fish comes mainly from the Mekong River and its tributaries. There are about 590 fish species in Lao waters, 94% of which are native, but 17 species of economic importance play a role in aquaculture, especially in small-scale farming and fish supply. Aquaculture production is of increasing importance, reaching 113,000 tons in 2019 (FAO, 2021). The development of aquaculture production between 2009 and 2019 is shown in Figure 1. Although the accuracy of the data provided is questionable, the increase in aquaculture production is clear. The species composition of aquaculture is shown in Figure 2 in 2019, according to which the dominant species in production (36,000 tons, 32% of total production) is tilapia, which is intensively farmed in cages located in larger rivers. The three Chinese herbivorous species together account for 22% and the three Indian carp species for 17% of total aquaculture production. Carp accounted for 6.2% of total production in 2019 (FAO, 2021). In the Lao PDR, the following three main production technologies are currently dominant in the aquaculture sector (Phommavong, 2010):

Fish production in cages: Tilapia production is dominant in cage fish culture, which has developed dynamically over the last 20 years and has become the most important sector of Lao aquaculture.

Pond fish production: Pond fish production is a traditional but still significant sector of aquaculture in the Lao PDR, which is the basis of livelihood for many people living in rural areas. The main fish species cultured in ponds are Chinese herbivores, Indian carps and common carp.

Integrated fish production: As in other Asian countries, the Lao PDR has a specific feature of integrated fish production such as animal husbandry; rice production and fish farming (Popp et al., 2018).

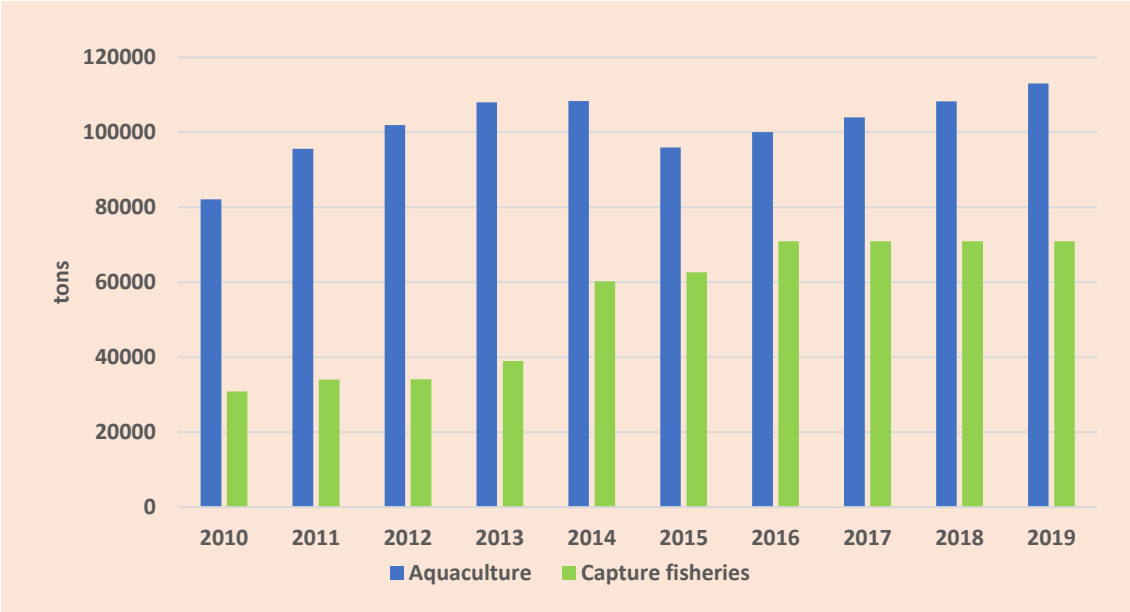

Figure 1. Aquaculture production shows a growing tendency, while capture fisheries is levelling in the Lao PDR (Source: FAO 2021)

Figure 2. Species distribution in aquaculture production in the Lao PDR (Source: FAO 2021)

2. Aquaculture value chain in the Lao PDR

In the Lao PDR, the conditions for the development of aquaculture systems and technologies are particularly favorable, considering the availability of resources and the progress made in the field of economic development in recent years. There is limited R&D activity in the Lao PDR to develop sustainable aquaculture systems, although environmental, economic and social sustainability are also becoming increasingly important in the development and key elements in increasing competitiveness. In addition to a clear economic criterion for sustainability, environmental sustainability, compliance with stricter environmental criteria and social sustainability are becoming increasingly important in the Lao PDR. This includes improving the livelihoods of those living in rural areas, but also meeting the needs of environmental- and health-conscious customers. Increasing the competitiveness of Lao aquaculture is particularly important, as the Lao PDR is also a member of the ASEAN

Economic Community, within which food products move duty-free. This is an opportunity but also a major challenge for the Lao PDR, where valuable "green" and human resources are available for food production, including fish production, but resource-efficient and environmentally friendly technologies are still lacking, and processing, packaging and marketing are underdeveloped.

Given the complexity of aquaculture development, the sustainable development of Lao aquaculture requires a systematic analysis along the entire value chain. The schematic structure of the fish value chain in the Lao PDR is shown in Figure 3.

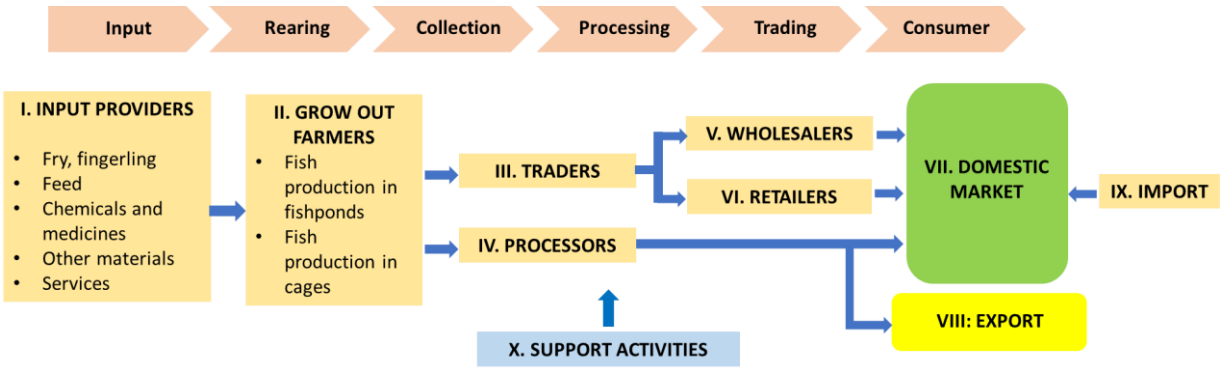

Figure 3. Scheme of the fish value chain in the Lao PDR

3. Analysis of the fish value chain in the Lao PDR

There have been efforts to increase sustainable production of fish and improve the quality and safety of fish products by the government and donors including the Hungarian government, however no systematic analysis has been made so far in the fisheries and aquaculture sector. In the frame of the 3rd Hungarian agricultural tied aid loan program, one of the key activities of the Fisheries and Aquaculture component is the execution of a Value Chain Analysis (VCA).

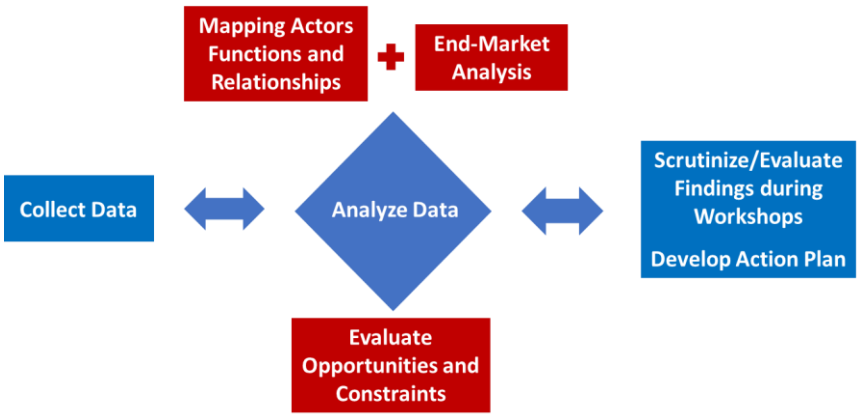

Figure 4. Steps of the Vale Chain Analysis (VCA) carried out in the frame of the 3rd Hungarian agriculture tied aid loan program

Data collection, mapping of actors, functions and relationships and also end-market analysis have been started in collaboration between experts of Vitafort Agro Asia Co. (VAA) from Hungary and the Department of Livestock and Fisheries (DLF) of the Ministry of Agriculture and Forestry (MAF) in the Lao PDR. The aquaculture development component of the Hungarian tied aid loan program is a very complex one, that includes the development of high-quality fish seed and fish feed supply, development of market size fish rearing technologies, development of fish processing and fish marketing. The program also includes human resources development and institutional strengthening through the development of bilateral R&D and training collaboration between

Hungarian and Lao aquaculture research and training institutions especially the cooperation between the National University of the Lao PDR (NUoL) and the University of Agriculture and Life Sciences (MATE).

Based on findings and recommendations of the VCA an Action Plan will be elaborated that will contribute the efficient implementation of the aquaculture component of the Hungarian agriculture tied aid loan program and the achievement objectives of the program according to the followings:

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- Reaching higher profits of actors along the value chain;
- Assisting the creation of more stable market conditions;
- Creating jobs;
- Diversifying products and markets;
- Contributing to the improvement of food security and food safety;
- Reducing post-harvest losses;
- Maximising sustainable management of resources;
- Assisting the better involvement of stakeholders in planning and governance;

4. Conclusions

Fisheries and aquaculture have been traditional activities in the Lao PDR based on the utilization of the rich aquatic resources of the country and contribute to animal protein supply and employment in many regions. However, there are still opportunities for the sustainable use of water resources especially by aquaculture. Sustainable development of aquaculture, however, is facing great challenges such as increasing needs for the responsible use of resources, changing socio-economic conditions, and climate change. The Hungarian government assists aquaculture development that is a component of a complex agriculture development program financed through a tied aid loan scheme. The aquaculture component of the program is a very complex one, therefore its planning and implementation requires a holistic and systematic approach to reach specific objectives. Using the fish value chain analysis as an appropriate method, an action plan is developed to help the efficient implementation of the aquaculture component of the Hungarian agriculture tied aid loan program and contribute to the improvement of food safety and food security through the supply of nutritious, healthy and safe fish and fish products to the markets.

5. References

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RESULTS OF TESTING HUNGARIAN VARIETIES IN THE SOIL AND CLIMATIC CONDITIONS OF THE REPUBLIC OF UZBEKISTAN

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Abstract

According to the cooperation agreement signed between the Hungarian University of Agriculture and Life Sciences - Potato Research Center and the Ministry of Agriculture of the Republic of Uzbekistan in Budapest on February 17, 2021, 6 Hungarian selection - *"Arany chipke", "Balatoni Rozsa", "Demon", "Botond", "White Lady", "Balatoni Sarga"* varieties of potatoes were brought for testing in the soil and climatic conditions of the Republic.

The distribution was carried out by regions and institutions for testing imported potato varieties. The tests were carried out in the Bostanlyk, Tashkent and Samarkand regions at the experimental stations of the Research Institute of Vegetables, Melons crops and Potatoes.

Key words: Hungarian selection, variety samples, soil-climatic conditions, seedlings, drip irrigation system, plant protection, pest infestation, flowering.

In Uzbekistan, potatoes began to be grown as an agricultural crop in the second half of the XIX century. In the early XX century, the area under potatoes was 1.4 thousand hectares, in 1940 – 23,6 thousand hectares, in 1991 - 40 thousand hectares, the yield was 8,5 tons and the gross yield was 341,2 thousand tons, and 16-17 kilograms per capita.

Today, potatoes are grown in more than 130 countries around the world for a total of 21,5 million tons. It is planted on an area of 351 million hectares per year. more than a ton of potatoes are grown. In the world, potatoes are second only to wheat, rice and corn, and second in importance. Potatoes are a source of protein, starch, various vitamins, mineral salts, as well as macro and micro elements that are important for humans. There are 26 elements in the Mendeleev periodic table. Potato chips contain 76,3% water, 23,7% dry matter, 17,5% starch, 0,5% sugar, 1-2% protein, 1% mineral salts.

Potatoes are important in ensuring the food security of our country. Therefore, potatoes are called ham "second bread". Decree of the president of the Republic of Uzbekistan on measures to ensure more effective organization of the process of acquisition of rights over land parcels and other immovable property as part of the South Caucasus pipeline expansion project more - According to the decision of the Cabinet of Ministers dated December 20, 2019 "On the rational placement of agricultural crops for the harvest of 2020 years and the projected volumes of crop cultivation" in the Republic of Karakalpakstan and regions in 2020 year as the main crop is planned to place potatoes in the fields of 30,4 thousand hectares and 35,1 thousand.

Currently, potatoes are grown in 138 countries in 20-22 million countries. planted on 320-335 million hectares. tons of gross crop is grown. Developed potato growing countries are China (72 million tons), Russia (35,7 million tons), India (26,3 million tons), Ukraine (19,1 million tons), the United States (17,7 million tons), Germany (11,6 million tons), Poland (11,2 million tons), Belarus (8,5 million tons), the Netherlands (7,2 million tons), France (6,3 million tons) etc., the average yield is 15-17 t/ha worldwide.

Nowadays, the choice of healthy plants based on appearance for potato seed serves as the main starting material creation method. However, for the cultivation of elite seed potatoes, the selection of healthy plants from seed pods by visual method using simultaneous serological and immunoenzyme analyzes can be effective.

6 Hungarian selection *"Arany chipke", "Balatoni Rozsa", "Demon", "Botond", "White Lady", "Balatoni Sarga"* samples of potato varieties were planted in Tashkent, Samarkand, Bostanlyk experimental fields of the Research Institute of Vegetable, melon crops and potato. The experiment was placed in 3 rows in the next period, planting scheme 70×25 cm, row length 5 m, 3-row digging. The total area of the experiment was 189 m^2.

The field around the experiments was cleared and the field was cleared of weed roots. In autumn, 20-25 tons of organic fertilizers per hectare were applied to the experimental field.

Samples of potato varieties were planted in early spring. During the growing season, 2 cuttings, 2 cultivations and ditches were taken between the rows of potato plants, and 3824.6 m^3/ha was used for drip irrigation and 7452,7 m^3/ha was used for irrigation. Drip irrigation saved 48,7% of water compared to ditch irrigation (Table 1).

Table 1.

Distribution of potato cultivar samples brought for testing from Hungary

№	Name of organization	Name of potato variety samples, number of provided bundles, pcs					
		"Arany chipke"	"Balatoni Rozsa"	"Demon"	"Botond"	"White Lady"	"Balatoni Sarga"
1.	Tashkent Experimental Station of Research Institute of Vegetable, melon crops and potato	180	180	180	180	140	180
2.	Bostanlyk Experimental Station of Research Institute of Vegetable, melon crops and potato	580	710	480	580	170	570
3.	Samarkand Scientific Experimental Station of Research Institute of Vegetable, melon crops and potato	50	50	50	50	50	50

Samples of potato varieties imported from Hungary were placed for sowing (harvesting) in a special room with air temperature + 14-18^{0}C, humidity 70-80% before planting and were sown in 20-25 days after sowing.

Seedlings of potatoes were planted on April 13, 2021 at a depth of 8-10 cm in the experimental fields of the Research Institute of Vegetable, melon crops and potato.

A drip irrigation system was installed on the experimental site, and irrigation and feeding of plants was carried out automated through this system. The plants were watered on average once every 3 days.

Measures against plant pests and diseases were carried out on the basis of biological and chemical drugs recommended by scientists of the Laboratory of Plant Protection from Diseases and Pests of the Institute. The fight against the butterfly of the potato moth was carried out on the basis of pheromone catchers.

In the study, the *"Pskom"* variety was taken as standard. In 10-75% of all cultivar samples planted, there was no significant difference from the standard navigator in the period from seedling emergence, mass germination to flowering. Accordingly, in all cultivars planted, 10% of seedlings took 14-18 days to germinate, while 75% took 23-27 days to germinate. It takes 32-37 days for 10% of the sprouted seedlings to germinate, while the longest-lasting variety *"Balatoni Sarga"* takes 10% of 37 days to germinate. The flowering period of 75% of the planted variety samples was 35-40 days (Table 2).

Table 2

Results of phenological observation of early planted samples of Hungarian potatoes. (2021)

Variety samples	Sprouting, day		From the day it sprouted			
			budding phase		Flowering (bloom)	
	10%	75%	10%	75%	10%	75%
Arany chipke	14	23	23	34	26	35
Balatoni Rozsa	15	26	27	35	28	37
Botond	14	25	24	32	25	34
Demon	17	25	23	34	26	35
Balatoni Sarga	18	27	26	37	27	39
White Lady	16	26	25	35	28	40
Pskom (st)	15	25	22	33	27	36

If the height of the stake of the *"Pskom"* variety planted in the comparison variant was 44,0 cm during the flowering period of the plant cover, depending on the characteristics of the Variety, It was determined that the *"Balatoni Rozsa"* variety was 32,2% higher than the standard, the *"Botond"* grade 16,8% and the *"Demon"* grade 10% higher than the stem. In the samples of *"Arany chipke", " Balatoni Sarga"* and *"White Lady"* varieties, there was no difference compared to the standard variety, that is, it was found that it was higher by 2-3 %.

In the period of experiments, the number of stalks in the plant was determined according to this, if the number of stalks in the standard *"Pskom"* variety was an average of 2,3 grains, the number of stalks in the samples of *"Botond", "Balatoni Rozsa"* and *"Balatoni Sarga"* was found to be 26,0-34,2% more than in the standard variety.

In the samples of *"Balatoni Rozsa", "Botond", "Demon"* varieties were 14-27% higher than the standard, while the height of the stake in the standard grade *"Pskom"* during the harvest period was an average of 50,1 cm, and the samples of other varieties practically did not differ from the standard grade.

Due to the peculiarities of the variety *"Balatoni Sarga", "White Lady"* it became known that in the samples of the Variety the color of their flowers is white, while in the samples of *"Arany chipke", "Balatoni Rozsa", "Botond"* and *"Demon"*. The Color of the flower is white pink and pink (Table 3).

Table 3

Samples of potatoes with biometric indicators

Samples of varieties	During the flowering period of the leaves of the plant				Stem height at harvest		Plantcolor
	height of potato tops		amount of potato tops				
	cm	St. relative, %	piece	St. relative, %	cm	St. relative%	
Arany chipke	45,0	102,0	2,1	91,0	51,2	102,1	White pink
Balatoni Rozsa	58,2	132,2	2,9	126,0	64,0	127,7	White pink
Botond	51,4	116,8	3,1	134,2	57,2	114,3	pink
Demon	48,8	110,0	2,5	108,6	58,1	115,9	pink
Balatoni Sarga	46,2	105,0	2,9	126,0	54,4	108,5	white
White Lady	45,5	103,0	2,4	104,0	52,5	104,7	white
Pskom (st)	44,0	100,0	2,3	100,0	50,1	100,0	white

While the number of endings in one tuber of potato varieties was an average of 6,0 grains in the standard variety *"Pskom"*, the number of endings in the *"Demon", "White Lady"* and "*Balatoni Sarga* " varieties was 8,3-

10,0 pieces and was 2,3-4,0 pieces compared to snandart. Alternatively, if the weight of the nodes is almost 50% higher, that is, 0,327 g in the standard variety. The average weight of the nodes in one Bush in samples of varieties brought from vengria was 0,672-0,693 g. Only the average number of endings in one Bush of the "*Arany chipke*" variety is 5,6 and the weight of one ending is 0,268 g, it turned out that this indicator is lower than the standard variety.

In the samples of the tested varieties, mainly fuzariosis was more common, and in the samples of the "*Balatoni Sarga* ", *"White Lady"* and *"Demon"* varieties were damaged 14-17 percent, in the samples of *"Botond"*, *"Balatoni Rozsa"* 8,0-10,0 percent, while in the samples of the standard varieties were damaged 17%. Strongly infected with fuzariosis was a sample of the nav " *Arany chipke*", this indicator was 21,0%, with phytophthora disease the incidence was 12%. Samples of other varieties were inconspicuous compared to the standard nai of lesions with phytophthorosis (Table 4).

Table 4.

Yield of potato samples and pest infestation

Variety samples	Number of tubers in one bush, pieces	Weight of tubers from one bush, g	Producti vity, t/ha	relative to control,%	Plants affected by diseases, in %		
					Fusariosis	Phytophthora	Anthrac nose
Arany chipke	5,6	0,268	15,3	82,2	21,0	12,0	2,1
Balatoni Rozsa	6,2	0,672	38,3	209,1	10,0	3,0	-
Botond	6,7	0,693	39,5	212,0	8,0	2,0	-
Demon	8,3	0,449	25,5	137,6	17,0	4,0	1,0
Balatoni Sarga	10,0	0,458	26,1	139,7	14,0	3,5	2,0
White Lady	8,4	0,493	28,1	151,0	15,0	4,0	-
Pskom (st)	6,0	0,327	18,6	100,0	17,0	5,9	2,3

Conclusions

1. All the Hungarian varieties samples studied sprouted and developed in the fields of planted experience. The average dressing in the *"Pskom"* variety studied by comparison was 18,6 tons, while the highest yield was 39,5 tons in the *"Botond"* variety. This indicator was higher by nsbatan 112 % to the standard. According to one-year experience, since the "*Arany chipke"* variety is not fully adapted to the soil-climatic conditions of the Republic, the average shelf life was 3.3 tons less than the standard variety.

2. When it was determined by the method of tasting, it was found that the taste of the nodules in the varieties *"Balatoni Rozsa"* and *"Botond"*, whose yield was the highest, was much better than in the samples of other varieties, and the shape of the nodules was marketable.

3. In the samples of the tested varieties suffered mainly fuzariosis disease, while in the snandart varieties the degree of damage of average plants was 17%, in the samples of "09-688", *"White Lady"* and *"Demon"* 14-17%, in the varieties of *"Botond"*, *"Balatoni Rozsa"* 8,0-10,0%. The degree of damage with phytophthoresis was 12% in all experimental areas.

Based on one-year experience, it is recommended to plant "Balatoni Rossa" "Botant" and "White","Demon", "*Balatoni Sarga*" varieties in the 70×25 scheme in the conditions of our Republic.

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PERCEPTION OF COMMUNITY GARDEN LEADERS TOWARDS ENVIRONMENTAL CONCERN AND FOOD SAFETY DURING THE PANDEMIC

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Abstract

The world is currently experiencing the Covid-19 crisis which starts in early 2020. As a result, The Government of Malaysia enforced a Movement Control Order (MCO) starting on March 18, 2020 to break the chain of COVID-19 and it has a significant impact on supply chains causing a problem in accessing perishable items for example fresh vegetables and fruits. Community gardening practices have the potential to overcome this problem as they can contribute to fresh vegetables addressing the problem of food safety during the pandemic. This study aims to determine the establishment of the new community gardens during the pandemic and the perception of community garden leaders on community garden practices. One hundred and twenty-six community garden leaders' responses were recorded and used. The findings revealed that there was a significant upward trend of community garden establishment during the pandemic. This paper also categorized the perception of urban farmer leaders on the community gardens practices into five groups including their attitude towards environmental concern and food safety. Another four groups are ease of use, subjective norms, perceived behavioral control and their intentions to continue their community gardens. The findings of this study can extend the understanding of community garden leaders' attitudes, behaviour, and driving mechanism toward sustainability of community gardens, and can help decision-makers to design better policies for community garden planning and management.

Keywords: Covid-19 crisis, Movement Contro Order, Community gardens, perceptions, food safety

1. Introduction

Community gardens have started to get the attention of the world community because of their potential in providing green space to generate fresh food sources, create community unity, relationships with the environment, add knowledge and generate income (Zaidi et al., 2019). The community garden project is one of the concepts in the urban agriculture program undertaken by the local community through a combination of crops and conservation in areas or derelict spaces around the settlement by using good farming methods, materials that are easy to find, easy to use and economical (Islam & Chmhuri, 2012). Since 2014, to date, a total of 124,988 people including those from schools, institutions, individuals and communities in 5,065 locations nationwide have been involved in the community garden program. In 2020, MAFI has allocated RM10 million which can benefit 800 communities. The implementation of the PENJANA Urban Agriculture Project is aimed at helping to reduce the cost of living of urban and suburban residents affected by the Movement Control Order (MCO). In addition, this program can create social interaction and encourage communication among urban communities which in turn can help in ensuring food security in the country during the pandemic (MAFI,2020).

The community garden is expected to continue to grow supported by the expanded consumer base established during the COVID-19 crisis. In particular, consumers' increased interest in growing their vegetables is expected to have an enduring effect on behaviour, supported by the prominent health and wellness trend, which has received a boost from the pandemic. Rising health consciousness and awareness of the chemicals used in pesticides are set to lead to more consumers growing organic fruit and vegetables, especially those living in urban areas, with this driving demand for seeds and pots and planters.

With the current situation of COVID-19 pandemic, food safety guidelines become the most important requirement enforced in food industries as demanded by consumers and authorities (Md Saad et al., 2021). Consumers had to change their purchasing behavior and take more frequent homemade meals instead of dining in the restaurant to follow stay-at-home orders. More people have the interest to involve in the community garden to ensure the vegetables are free from excessive chemicals and microbial contamination. Malaysia government has introduced the Food Act (1983), Food Regulation (1985) and established the Food Safety and Nutrition Council in 2001 to reduce contamination and poisonous incidents in food. Among strategies from the government is to educate consumers to raise their awareness on food safety which is supported by implementing a community garden.

From the previous studies, many have paid attention and focused only on the potential and benefits of the development and implementation of community gardens. In fact, studies conducted in Malaysia are also limited such as project development and implementation challenges, goals, finance, equipment and sponsorship which are some of the problems faced in community garden development (Zaidi et al., 2019) Support from relevant agencies for the development of community garden projects is seen to be increasing, but it now questions about the impact of the projects on the community especially in this challenging period. Therefore, this matter needs to be given attention to ensure that urban community gardens can be carried out continuously among the urban population to reduce the number of food imports in the country even after the pandemic. A study by Kaiser (2015) has shown that community garden has improved food safety situation among the urban gardeners when they involve in gardening activities for the long-term period. It involves a reduction of the soil contamination with heavy metal contents. Another study related to food safety in community garden has been conducted by Spliethoff (2016). The study found that the replacement of root-zone bed-soil with clean soil may reduce the heavy metals exposure to gardeners.

Numerous articles have drawn attention to the benefits attached to urban farming. The current study will contribute to the literature by adding more studies emphasizing community garden role in ensuring food safety. The specific objective of this article is to assess the perception of community garden leaders on the food safety concern specifically during the COVID-19 pandemic period.

2. Methodology

The study gathered the data is provided by the Department of Agriculture, Malaysia involving 126 community gardens in Malaysia. The primary data were collected through structured face to face interviews with 126 community garden leaders conducted between September 2021 and January 2022. Data on the establishment of community gardens were analysed using descriptive analysis and the community garden leader's perception were investigated. The respondents were asked to rate each item described in the questionnaire on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). The Exploratory Factor Analysis EFA was conducted with SPSS to test data reliability by calculating the Cronbach's alpha of all observed variables (Tenenhaus et al., 2005). This step tested whether measurement models of community garden leaders' perceptions of attitude towards environmental concern and food safety, ease of use, subjective norms, perceived behavioral control and their intentions to continue their community gardens.

3. Result and discussion

Figure 1 display the number of community garden establishment in Malaysia. From the survey, data during pandemic significantly increasing and it is due to government intervention by subsidizing material via the implementation of the PENJANA Urban Agriculture program.

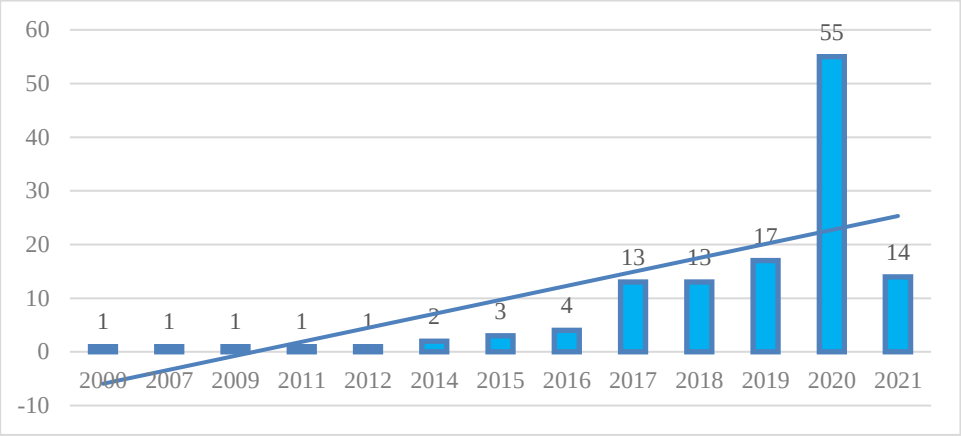

Fig. 1. *Number of registered community garden in Malaysia (Field Survey,2022)*

Table 1. *The result for the reliability, KMO and Bartlett's Test*

Number of items		31
Cronbach's Alpha		.845
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.835
Bartlett's Test of Sphericity	Approx. Chi-Square	2029.401
	df	351
	Sig.	.000

An Exploratory Factor Analysis (EFA) was conducted to assess the reliability and validity of the construct measures. Cronbach's alpha was used to measure the reliability of each construct in the questionnaire. As shown in Table 1, the Cronbach's alpha of all constructs is 0.845, exceeding the standard of 0.70 which indicates that all constructs in the questionnaire are internally consistent and reliable (Fu et al., 2020). The convergent validity and discriminant validity are also useful indicator that the EFA performed well with the KMO value is 0.835, and the P-value of Bartlett's test of sphericity is significant (Yunus, F., 2010).

Table 2. *The result of the EFA on the perception of community garden leaders on the community garden practices.*

	Component				
Item	Attitude towards environmental and food safety concern	Ease of use	Intention	Subjective norms	Perceived behavioral control
Community garden improves physical and mental health.	.822				
Community garden contributes to good air quality.	.817				
Community garden reduces environmental pollution.	.795				
Community garden promotes a healthy diet (organic vegetables and fruits).	.765				
Community garden helps me to be more concerned with the environment.	.752				
Community garden gives me confidence about my food sources.	.747				
Community garden gave me many friends.	.659				
It is easy for me to provide Community garden infrastructure and equipment.		.800			

Community garden is easy to manage.		.736			
Agricultural inputs are readily available.		.681			
Access to urban agricultural technology information is easy.		.575			
Community garden can improve the quality of vegetables/fruits/fish farming.		.507			
Overall, I am satisfied with the Community garden.			.765		
I have a deep interest in Community garden.			.681		
I will continue Community garden for a long time.			.658		
Good monitoring from nearby Departments/Agencies.				.847	
Community garden advisory services from Departments/Agencies are encouraging.				.743	
Overall, this Community garden can reduce the cost of living of participants in your area throughout the MCO.				.526	
Community garden increases personal and community income.					.682
Community garden helps generate income.					.641
Community garden can reduce the cost of spending on kitchen items.					.591
% of variance	20.831	11.106	10.286	8.337	7.445
Total Variance Explained	58.005%				

Table 2 provide the components or factors of the leaders' perception that are categorized by using the EFA method. The factors are arranged in descending order based on the most explained variance and for social science research, the extracted factors usually explain only 50% to 60%. In this study the total variance explained is 58.005% indicating a good model (Yong and Pearce, 2013).

This study focuses on the main factors that explained the most variance is an attitude towards environmental and food safety concern. The widely accepted definition of environmental concern provided by Dunlap and Jones (2002) refers to the extent to which people are aware of environmental problems and support efforts to solve them. Most studies have confirmed through empirical research that environmental concern increases the intention to engage in pro-environmental behavior (Verma et al., 2019). In particular, the food safety concern has received a boost from the pandemic. Rising health consciousness and awareness of the chemicals used in pesticides are set to lead to more consumers growing organic fruit and vegetables, especially those living in urban areas, with this driving demand for seeds and pots and planters.

4. Conclusion and recommendation

Community gardening can contribute to community food security not only by helping to address issues of accessing nutritious food and food safety but also by improving the well-being of individuals and families. Hence, it is hoped that community farming's sustainability can be maintained through programs and policies that support urban farming producers. In addition, more resources need to be allocated to provide community garden space and learning opportunities to all gardeners. This way, the sustainability of urban farming in Malaysia might be preserved. This study has revealed the perceptions of community garden leaders through performing community gardens in the COVID-19 situation. However, the analysis in this study presents only in a descriptive manner. Future studies such as to model the sustainability of community gardens are highly recommended in order to highlight the importance of urban farming to community food security.

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THE ALTERNATIVES OF RICE STRAW DEGRADATION AND WATER MANAGEMENT TOWARDS SUSTAINABLE ENVIRONMENTAL QUALITY

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Abstract

The current practice of paddy planting in Malaysia was using flooding method and burning straw activity that leads to a release of CH4 which will affect on the reduction in the function of the ecosystem around the area. Research addressing these issues from the economic point of view is very limited. This article provides the environmental and economic impact assessment for alternative rice straw and water management at paddy cultivation areas in MADA and IADA Barat Laut Selangor. The benefit cost ratio (BCR) analysis was employed to compare both practices in terms of financial saving and economic incentives that were converted into monetary value. The total monetary valuations for alternative water management ranging from MYR15,188,644.55 to MYR16,014,742.45 per season. As for straw management, it was valued at MYR2,788,615.45 per season if the optimistic scenario was implemented nationwide. The results from the study suggested that an environmental quality (emission reduction by 8.7% and in between 34.5% to 36.3% for straw and water management alternatives, respectively) through economic evaluation exercise providing a more accurate picture for the policymakers, rice farmers and related agencies to adopt and enhance the usage as well as transferring the technology in order to replace the price of their environment.

Keywords: benefit cost ratio; monetary value, paddy cultivation, rice straw management, water management

1. Introduction

In Malaysia, rice cultivation contributes to greenhouse gas (GHG) emissions in the environment. One of the main contributors that release the greenhouse gases (CH4, CO2 and N20) is related to the field activities, such as the water consumption quantities and the conventional practice on discarding the rice straw (Rahman et al. 2019; Sariam and Anuar 2010). Generally known, Malaysia uses flooding method for rice cultivation that leads to CH4 emission. Then, after harvesting, most of the farmers perform an open burning of dry straw. It was regularly practiced as it is the easiest way to dispose of the straw. Hence, this activity affect the functioning ecosystem around the area.

Various techniques and innovations of water and straw management were developed to find the optimal use of water in rice cultivation, and adding value to rice straw rather than disposal. However, it still not implemented vastly throughout the granaries. It might be due to the investment cost or the developed technology still not transferred to the local farmers.

2. Material & Methods

This study covers two main subjects; the reduction of environmental pollution emission, and the estimated monetary benefits that can be obtained if alternative management of rice cultivation is implemented. Two areas, Muda Agricultural Development Authority (MADA) and Integrated Agricultural Development Authority (IADA) Barat Laut Selangor (IADA BLS) were selected for the experimental as a plot testing. The conventional plot was carried out by nearby farmers who practice the conventional way of paddy cultivation (status quo) with the same hectares size as the experimental / treatment plot. Data was collected by researchers which are includes the data of the technical parameters and production costs. All data that were recorded started from early planting season.

This study focused on the environmental impact of water and straw management at paddy cultivation areas. The experiment was carried out by comparing the traditional practices with the new practices of water and straw management. For water management assessment, it was conducted by comparing water consumption rates between several irrigation methods for rice cultivation (T1(control) = Continuous flooding throughout the season (3-5 inches of standing water), T2 = Saturated conditions from tillering stage until heading and flooding until maturity & T3 = Saturated conditions throughout the season (without standing water)) (Table 1).

Table 1. Alternative Management of Water Management in Rice Planting Experiment

Treatment	Water Management Alternative
T1 (Control)	Continuous flooding throughout the season (3-5 inches of standing water)
T2	Saturated conditions from tillering stage until heading and flooding until maturity
T3	Saturated conditions throughout the season *(without standing water)*

As for the rice straw, comparisons were made between open burning rice straw method and disposal through microbial methods (T1(control) = Without microbe & T2 = With microbe). The comparison showed in this study will projecting the economic incentives value to be received by farmers that willing to adopt the alternatives of water and straw management in their cultivation activities and create awareness of the importance of caring for the environment (Table 2).

Table 2. Comparison of Straw Management Practices in Rice Planting Experiment

Item	Without Microbe (T1 Control)	With Microbe (T2)
Method	• Straw burning (dry season) • Soil incorporation (wet season)	• Dumped (1.5 - 2.0 meters) • Use of microbes is active • It took about 3 weeks
Advantages	• Killing soil pathogens	• Restores essential nutrients (NPK, Ca, Mg, S & Si)
Disadvantages	• Stimulates germination of weeds & rice paddy • Environmental pollution • Affects the rate of seed germination • Loss of 8 - 10% of K element	• Stimulates the germination of weeds and rice paddy • Specific moisture and temperature requirements
Cost (wage)	• MADA – MYR60 • IADA BLS – MYR128	• Not yet determined

3. Results & Discussion

The monetary benefits for environmental purposes can be determined by intangible benefits that come from reducing the GHG emissions for both alternative practices: water and rice straw management. The conventional methods were valued by the farmers' common practices, including burning and soil incorporation for hay to microbial use per hectare, whereas, water-saving was valued by a reduction of methane emissions (CH4) by 36% (MADA T2) and

34% (MADA T3) as the alternative. For water-saving, each monetary value of recorded total emission was estimated at MYR 130.94 and MYR 134.80 per hectare, respectively, and for rice straw, the monetary value was at MYR 137.47 per hectare (Table 3).

Table 3. Comparison of GHG Emission between Conventional and Alternative Practices

Indicator/Item	Straw Alternative (IADA BLS)		Water Alternative (MADA)		
	T1	T2	T1	T2	T3
Total Emission Calculated (mg/m2/season)	9,599.23	8,768.42	13,125.1	8,352.38	8,598.34
Reduce Methane Released (%)		0.0865		0.3636	0.3449
Total Emission Calculated (kg/hectare/season)	95.99	87.68	131.25	83.52	85.98
Total Released (MT/ hectare/season)	0.10	0.09	0.13	0.08	0.09
CO_2 Equivalent (MT)*	2.40	2.19	3.28	2.09	2.15
Current Price (MYR/ MT CO_2 Eq)**	62.71	62.71	62.71	62.71	62.71
Total Price Released (MYR/MT/hectare/season)	150.50	137.47	205.77	130.94	134.80

Source: *Estimated CO2 equivalent to metric tonne (Brander and Davis 2012), **estimated current price in US dollars (converted to Malaysian Ringgit) equivalent to metric tonne of CO2 (Brad and Nadja 2019)

The monetary values were determined from the differences between conventional practices and the alternatives, in which they were converted to tangible benefits rather than intangibly viewed as only an increase in environmental quality. A substantial amount of conservation could be achieved if the alternative practices in water and straw management could be practiced throughout the granaries in Malaysia. There are 10 major areas of rice cultivation in Malaysia with varying cultivars. If the alternative management method was implemented, the conservation values was estimated in ranging between MYR7,145,614.45 to MYR7,534,258.55 per season at MADA area and between MYR1,352,475.29 to MYR1,426,035.31 per season at IADA Barat Laut Selangor (IADA BLS) area. For straw management, it represents a conservation value of MYR1,311,925.55 per season (MADA) and MYR248,312.71 per season (IADA BLS). About 8.7% of the conservation value can be enjoyed with the use of alternative straw management while for alternative water management it is between 34.5% to 36.3%.

4. Conclusion

The alternative practices might not be referred to the increase in farmers' income itself, but rather it should be evaluated in terms of environmental awareness towards the safety of the surrounding area. This was measured by the reduction of GHG emissions of 8.7% for alternative straw and in between 34.5% to 36.3% for water management as estimated in the study. The subjective value of improving environmental quality was calculated and the results of the estimated value showed that the impact was beneficial for farmers to practice alternative management as part of their planting activities. Hence, this study could be used as a guide for the policymakers in determining a sustainable agricultural direction for the rice sector. The estimated monetary value will be a cost to the government in the future if no action is taken to preserve the rice planting activities. Therefore, any viable green technology should be adopted in order to achieve a sustainable environment.

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Nutritional status of Turkey berry (*Solanum torvum* Sw.*)* powder as influenced by three drying methods for commercial production

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Abstract

Drying methods influence on the physicochemical and mineral contents of Turkey berry (*Solanum torvum* Sw.) powder were assessed. The berries were steam-blanched for 10 min and dehydrated by either solar, sun or air-oven drying. The pH was 5.8 in raw berries compared to powder samples (5.3 - 5.7). Comparable values of TTA were 0.13, 0.12, 0.15 meq NaOH/100 g for air-oven, sun and solar drying, respectively. Drying caused significant changes in colour parameters as loss of greenness (+0.55) occurred in solar-dried berries. Turkey berries dried in air-oven retained their green colour better than those dried in solar dryer and sun. The 3 drying methods improved the mineral content significantly ($p < 0.05$) in the berry powder compared to the raw berries especially for iron (Fe). Air-oven drying method was better than solar and sun drying for preserving the green colour of the Turkey berry powder for commercial production.

Keywords: Turkey berry, drying methods, powder, nutrition, physicochemical properties

1.0 Introduction

Turkey berry (*Solanum torvum* Sw.*),* commonly called prickly night shade, devil's fig, wild eggplant or plate bush is among the wild edible plants used for food. It belong to the family *Solanaceae.* The berries taste bitter and sour and have a strong iron taste when eaten according to Badola, Mohinder, Bhanderi and Pal (1993). In Ghana, it is locally referred to as *Kwahunsusua* or *Abeduru* and often added to soups and stews in its raw form. It is locally believed that the berries are rich in minerals that boost blood production and therefore is used in preparations to prevent anemia. The berries have also been documented to exhibit anti-viral tendencies by Arthan, Svasti, Kitakoop, Pittayakhachonwut, Tanticharoean and Thebtaranonth (2002), while its leaves possess analgesic and anti-inflammatory properties as stated by Ndebia, Kamgang and Nkeh-Chungag (2007). According to Bandola et al. (1993), Turkey berry contains a number of pharmacologically active chemicals including saprogenin, steroid and chlorogenin. These antioxidants prevents cardiovascular diseases, stroke and cancer and aids in the treatment of asthma, chest congestion, piles, tuberculosis, anorexia, night blindness and repeated miscarriage. Extracts of the berries are used in the treatment of cold and cough ailments, liver and spleen enlargement. As indicated by Edmonds and Chweya (1997), the berries provide a good source of vitamins and minerals such as copper, iron, manganese and zinc, which are co-factors in metabolic and biosynthetic processes.

Turkey berries have a short shelf-life because of its thin skin and high moisture. They rapidly lose their rawness, wilt and or darken after storing for a few days. This reduces the utilization potential of the crop significantly. One of the strategies to overcome this limitation is to dry the berries into more stable form, which may store longer. Drying is one of the simplest, technologically and economically friendly means of preserving vegetables. Essentially, drying process removes moisture by the application of heat (Mujumdar, 2006). The source of heat may differ and may include direct solar radiation or heat generated by electricity. Drying reduces moisture content and may, by extension reduce water activity. This enhances the keeping properties of food by limiting

microbial growth and undesirable physical and chemical changes that may occur during storage (Ibarz and Barbosa-Canovas, 2000).

According to Gupta, Gowri, Lakshmi and Prakash (2013), dehydration presents a reasonable choice for preserving vegetables. However, different drying methods may have different effects on the physicochemical and mineral properties of the final product. Therefore, in a bid to extend Turkey berry shelf-life by drying, there is a need to ascertain the drying method influence on the content of these essential properties. This would create a better understanding about the conditions required to efficiently dry Turkey berry, with little loss in quality. The present study therefore sought to investigate the influence of air-oven, solar and sun drying methods on some physicochemical and mineral properties of *Solanum torvum* and determine the most efficient drying method for commercial production of dried Turkey berry powder products.

2.0 Materials and methods

2.1 Sample preparation

Solanum torvum was sources from a supplier at a local market in Accra. The berries were detached from the stalk, sorted and washed before pre-treatment. Portions of the berries were steam blanched before drying. Steam blanching was done by exposing the berries held in a colander to steam under atmospheric pressure for 10 min in order to reduce levels of harmful and anti-nutrient substances in the berries (Ejoh et al. 2005). Thereafter, the berries were immediately cooled under running tap water and drained completely before drying. The control samples used in this study were raw (fresh) Turkey berries.

2.2 Drying of berries

Steam blanched berries were divided into 3 portions of 1 kg each, and either sun dried, solar dried or dried in an air oven (mechanical drying). Sun drying was accomplished by spreading the blanched samples on stainless steel drying trays covered with a nylon net to prevent insects from coming into direct contact and drying directly under sun for 48 h. A second portion of the berries was dried in a tunnel solar dryer at an average temperature of 49.6 ± 5.3 °C for 48 h. The last portion was dried at 45 °C in an air-oven for 28 h.

2.3 Preparation dried samples into powder

Dried turkey berries were pulverized into fine powder (250 µm) using a hammer mill (Christy and Norris Ltd., Surrey, UK). The powder was packaged in flexible polypropylene pouches, sealed airtight and stored at 4 °C for physicochemical and mineral analyses.

2.4 Water activity and moisture content

Water activity (a_w) of samples (8 g) was measured using a Rotronic HygroLab 2 water activity meter (Rotronic AG, Bassersdrof, Germany). The equipment was calibrated using saturated salt solution of relative

humidity 70 % (0.75 a_w). The moisture content was determined using and electronic moisture analyzer (Sartorius GMBH, Gottingen, Germany).

2.5 pH and Total Titratable Acidity (TTA) determination

The pH and TTA of samples were determined using approved methods of the AOAC (2000) in triplicates.

2.6 Colour

Colour of samples was determined using a Minolta Chroma meter (CR-310 Minolta, Japan). The device was calibrated with a reference white porcelain tile ($L_0 = 97.63$, $a_0 = 0.31$ and $b_0 = 4.63$) before use. Colour of the samples was described in L* a* b* notation, where L* is a measure of lightness, a* defines components on the red-green axis and b* defines components on the yellow-blue axis. Colour difference (ΔE) and Chroma (C) was calculated using the relation;

$$\Delta E = \sqrt{[(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]} \quad \text{Eq. 1}$$

$$C^* = (a^{*2}+b^{*2})^{1/2} \quad \text{Eq. 2}$$

2.7 Mineral analyses

Trace metals of copper (Cu), iron (Fe), manganese (Mn) and zinc (Zn) of samples were determined by the method used by Ofori, Akonor and Dziedzoave (2016). Based on AOAC (2005), dry ashing method was used for the Atomic Absorption Spectrometry (AAS) analysis.

2.8 Quality Control

The method presented by Ofori et al. (2016) for ensuring quality control of the trace metals was used. Samples were handled carefully to avoid contamination as part of measures to ensure reliability of results. The recovery test of the total analytical procedures was also carried out for the trace metals analyzed in the selected samples by spiking analyzed samples with aliquots of metal standards and subsequently reanalyzed the samples.

Acceptable recovery ranges of 96 – 97, 93 – 95, 95 – 97 and 94 - 96 %, were obtained for Cu, Fe, Mn and Zn, respectively.

2.9 Data analysis

Data obtained from the experiments were collated and analyzed using one-way ANOVA SPSS 17.0.1 (SPSS Inc., USA). Duncan's Multiple Range Test was done to separate significantly different means ($p = 0.05$).

3.0 Results and discussion

3.1 Physicochemical properties

Physicochemical properties of Turkey berry powder is presented in Table 1. Some variations were noticed in the *pH* between the raw (control) and dried powder produced by the 3 different drying methods. The Turkey powder produced by solar drying had a significantly ($p < 0.05$) lower *pH* compared to air-oven and sun dried powder. However, the of the raw berry was higher (5.81) than any of the berry powder (5.27 - 5.65).

The Total Titrable Acidity (as % citric acid), which was indicative of the organic acid content of product was twice higher (0.12 - 0.15) in the berry powder compared to the raw berry (0.06). The high acidity value may be attributed to the concentration effect, which occurs due to moisture removal as reported by Morris, Barnett and Burrows (2004) in foods and similarly by Purkayastha, Nath, Deka and Mahanta (2013) in tomato fruits. However, in green leafy vegetables some organic acids such as ascorbic acid was reported to readily deplete when they were dehydrated (Gupta et al. 2013).

Table 1. Physicochemical properties of Turkey berry powder and raw sample

Sample	pH	TTA (meq NaOH/100g)	Water activity (a_w)	Moisture (g/100g)
Raw (Control)	5.81 ± 0.01^{a}	0.06 ± 0.06^{a}	0.87 ± 0.01^{a}	63.04 ± 0.76^{a}
Air oven	5.53 ± 0.01^{ab}	0.13 ± 0.10^{bc}	0.51 ± 0.02^{c}	3.88 ± 0.15^{c}
Sun	5.65 ± 0.01^{ab}	0.12 ± 0.06^{b}	0.49 ± 0.01^{bc}	3.71 ± 0.07^{bc}
Solar	5.27 ± 0.01^{b}	0.15 ± 0.10^{c}	0.40 ± 0.01^{b}	3.41 ± 0.04^{b}

Superscripts within the same column imply significant differences at $p \leq 0.05$.

3.2 Colour

According to Maskan (2001), colour influences products visual impression and contributes to its acceptability or rejection. Subsequently, colour losses are considered undesirable and may result from browning reactions or breakdown of colour pigments. All colour descriptors (L* a* b*) were affected by the 3 different drying methods (Figure 1). The raw (control) berries were greener than the Turkey berry powder samples. The powder samples from air-oven and sun drying had a significantly ($p < 0.05$) lower green colour compared to the solar dried powder (Table 2, Figure 1).

Chlorophyll and carotenoids are naturally responsible for the green colour of Turkey berries and its products, which was similar to the green colour of green pepper reported by Marin, Ferreres, Thomas-Barberan and Gil (2004). The reduction in the green colour of solar dried powder may be due to extensive browning resulting in lowered L* value. Additionally, the reduction in a* values (greenness) may have resulted from the degradation of chlorophyll, carotenoids, condensation of hexoses and amino acids and other oxidation reactions occurring in the course of steam blanching and drying (Lozano and Ibarz 1997; Lee and Coates 1999). According to Ahmed, Shivhare and Debnath (2002) and Lau, Tang and Swanson (2000), the green colour of various green plant products could be maintained by controlling chlorophyll degradation into pheophytin during thermal processing, since thermal processing may lead to a considerable darkening of products (Ahmed and Shivare, 2001). This observation was further emphasized by the total loss of greenness in the solar dried powder samples (a* = +0.55) (Figure 1). As indicated, the greenish colour of the raw berry was negatively affected by the drying processing as observed in the low values obtained after drying.

The Turkey berry powder from solar dried method had a rather reddish colour probably due to extensive browning, which occurred during solar drying of the blanched Turkey berries. The solar dried powder had approximately 50 % reduction in greenness. Additionally, yellowness remained fairly similar except solar dried powder samples, which had a significant ($p < 0.05$) reduction in yellowness. Similar trends were noticed in the Chroma and colour differences (AE) values, indicating more than 2-fold reduction resulting from the use of solar drying method. Colour of sun dried powder samples was closest to the colour of the raw berries whereas solar dried powder samples departed the most indicating a colour difference of 12.54 units (Table 2).

Table 2. Colour of Turkey berry powder and raw sample

Sample	Chroma	Δ E
Raw (Control)	15.76 ± 0.31^{a}	–
Air oven	14.20 ± 0.23^{ab}	11.10
Sun dried	12.04 ± 0.52^{b}	10.21
Solar dried	6.63 ± 0.29^{c}	12.54

Superscripts within the same column imply significant differences at $p \leq 0.05$

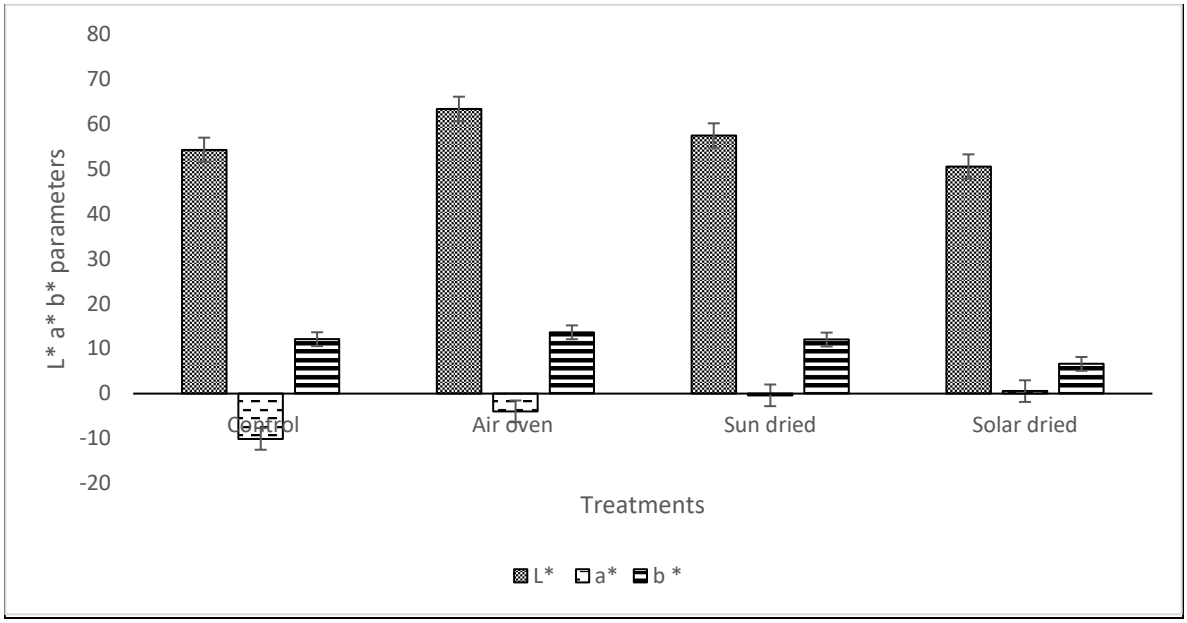

Figure 1: Colour parameters Turkey berry powder and raw sample

3.3 Minerals

The mineral content of the raw (control) and Turkey berry powder differs significantly ($p < 0.05$) (Table 3). The Fe content of the raw berry was higher (26.1 mg/kg) compared to the Cu, Mn and Zn (<10 mg/kg). Similarly, Fe content in the powder samples was higher (70.10 – 76.62 mg/kg) than Cu, Mn and Zn (7.96 – 24.85 mg/kg). The high Fe content was a boost for the consumption of Turkey berry powder as the Recommended Daily Intake (RDI) for Fe was 15 mg/Kg (WHO, 1982). Additionally, it was important for women in cases of haemopoietic control of infection and cell mediated immunity (Bhaskaran, 2001) as Fe deficiency in the body causes severe anemia as reported by Senesse, Meance, Cottet, Faivre and Boutron-Ruault (2004). The RDI for Cu was 2 mg/Kg and Zn was 15 mg/kg for men and 12mg/day for women, respectively. These RDI levels are less than that reported for Cu (12.08 – 15.88 mg/Kg) and Zn (17.90 – 22.24 mg/Kg) except samples of sun dried method that recorded lower Zn values (8.55 mg/Kg). Importantly, the drying methods were suitable for providing Turkey berry powder that meet the RDI levels for Cu and Zn.

Subsequently, the systematic consumption of the Turkey berry powder could help alleviate Zn deficiency, especially in sub-Sahara and other developing countries. However, Zn doses larger than 25 mg may cause anemia and Cu deficiency. Similarly, the RDI of Mn for children to breast-feeding mothers was 1.2 - 2.6 mg/Kg, which was lower than Mn (7.97 - 24.85 mg/Kg) observed in the Turkey berry powder. These essential minerals were similar to green leafy vegetables in earlier studied reported from Niger (Freiberger et al. 1998; Sena et al. 1998), Nigeria (Barminas et al. 1998), South Africa (Ndlovu and Afolayan, 2008), Ghana (Glew et al. 2010) and Cameroon (Ejoh et al. 2017).

Minerals are important in humans for proper bodily functions and healthy growth. Interestingly, Fe, Cu, Zn and Mn are among the essential elements required by people of all ages for growth and proper function. According to Frassinetti, Bronzetti, Caltavuturo, Cini and Croce (2006), Fe was important in the formation of hemoglobin and prevention of anemia, Cu was required for proper metabolic function, whereas Zn was needed for strengthening the immune system, stabilizing DNA and for gene expression and increase mobility in infants and children. Inclusively, Mn was required for the production of enzymes for biochemical activities in the body. However, above acceptable limits these minerals may distort proper function of the body. In support of this, Oyaro, Ogendi, Murago and

Gitonga (2007) indicated that accumulation of Cu in the body may result in nausea or vomiting, whereas excessive Zn may damage the pancreas or interfere with protein metabolism.

Generally, the process of drying caused water removal resulting in the high mineral values recorded in the Turkey berry powder compared to the raw berry. The 3 drying methods did not have any adverse effect on all the minerals analyzed. This is because mineral salts have low volatility, very stable and therefore were not degraded by drying temperatures used in this study. This observations corroborates findings reported earlier by Gupta et al. (2013), where the authors analyzed the retention of nutrients in leafy vegetables after dehydration. Similar observation were reported by Ahmed et al. (2002) on green chilies. This indicated that the 3 drying methods used for processing Turkey berry had limited adverse effect on its mineral contents.

Table 3. Mineral content (mg/kg) of Turkey berry powder and raw sample

Sample	Cu	Fe	Mn	Zn
Raw (Control)	3.85 ± 0.21^{a}	26.05 ± 3.69^{a}	6.97 ± 0.16^{a}	4.34 ± 0.42^{a}
Air oven	15.88 ± 0.18^{b}	76.08 ± 7.42^{b}	18.98 ± 1.24^{b}	17.90 ± 0.45^{c}
Sun	14.58 ± 0.22^{bc}	70.10 ± 0.89^{c}	24.85 ± 1.00^{c}	8.55 ± 0.09^{b}
Solar	12.08 ± 0.25^{c}	76.62 ± 7.13^{b}	7.96 ± 0.45^{a}	22.24 ± 0.85^{d}

Superscripts within the same column imply significant differences at $p \leq 0.05$

4.0 Conclusion

The study showed that changes that occurred when Turkey berry was dried using the 3 different drying methods were mainly physical, including lowering water activity and colour degradation. Solar drying method had the most negative influence and this was manifested in the high ΔE value obtained. The 3 different drying methods did not have any marked effect on mineral concentration. The air oven drying method of Turkey berry proved the most useful in preserving the green colour of Turkey berry powder and may therefore be considered as a good means of improving the storage stability of the Turkey berry in powdered form. Subsequently, the high incidence of iron-deficiency anemia in Ghana and sub-Saharan Africa could be addressed by processing Turkey berry, which are economically accessible into powder products for the populace.

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Redox potential as an alternative method for quantification and differentiation of microbes – A Review

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Abstract

This study provides an overview about the use of redox potential method as a simple, rapid, and useful alternative technique to the standard method for microbial analysis of foods, since it is based on the most complex activities of microorganisms which are the oxidation and reduction reactions. In this review we also evaluated some advantages and drawbacks of each method as well as the time required to establish the measurements, the selectivity, and the reproducibility, and we reflected how redox potential measurements can be useful for the differentiation among some species of lactic acid bacteria.

Keywords: Redox potential, colony counting method, Differentiation, microorganisms.

Introduction

To guarantee the safety and the hygienic quality of any food product, and to detect the risks of emergency, it is undoubtedly important to do a full microbiological analysis and detect all sorts of microbes that can grow in the product (Feng, 1996). For that reason, colony count method is the most common technique used until now for the detection of microorganisms. This method is based on the inoculation of a product suspension dilutions onto an agar growth medium that should be incubated in a temperature that match the specific growth conditions of the microbe (Jasson et al., 2010). Since this method involves basically a long time of incubation, many researchers start to invent and innovate new methods that are pretty much faster, easier, and useful for the examination of microbial growth (Erdosi et al.,2012; Jasson et al., 2010; Reichart et al., 2007). One of these new techniques is called Redox potential method, it is based on the oxidation and reduction activities of microbes. which are depending on several conditions, as the oxygen pressure depletion, the production of reducing compounds in the environment, and the consumption of the nutrients from the media. This parameter can be used in the purpose of the differentiation and characterization of microorganisms. In fact, if the redox potential of the nutrient medium starts decreasing, it means that the microorganisms begin their proliferation (Jacob, 1970; Szakmár et al., 2014).

Detection of microorganisms by redox potential measurement

This method captivates a respectful interest lately since it is a good alternative to the conventional method. What makes this redox potential measurement technique a competent alternative is that it is rapid, simple and it doesn't require dilution of samples and it helps a lot on having a faster examination of food safety. The evaluation of redox potential change of a medium is handled by a MicroTester system (Erdosi et al.,2012; Szakmár et al., 2014). This technique allows the tracing of redox potential curves in contrast of time and the determination of the Time To Detection value (TTD) which is the time when the redox potential decreases until it reach and exceed the detection criterion value (DC). According to this information a linear correlation between the TTD and the logarithm of the viable microorganism's growth could be established (Engelhardt et al., 2018). The redox-potential curve of *E.coli* is mentioned below as a representative of the redox potential curve appearance which is obviously resumed as a decreasing phase until a determined value and then it increases a little or it can stay constant.

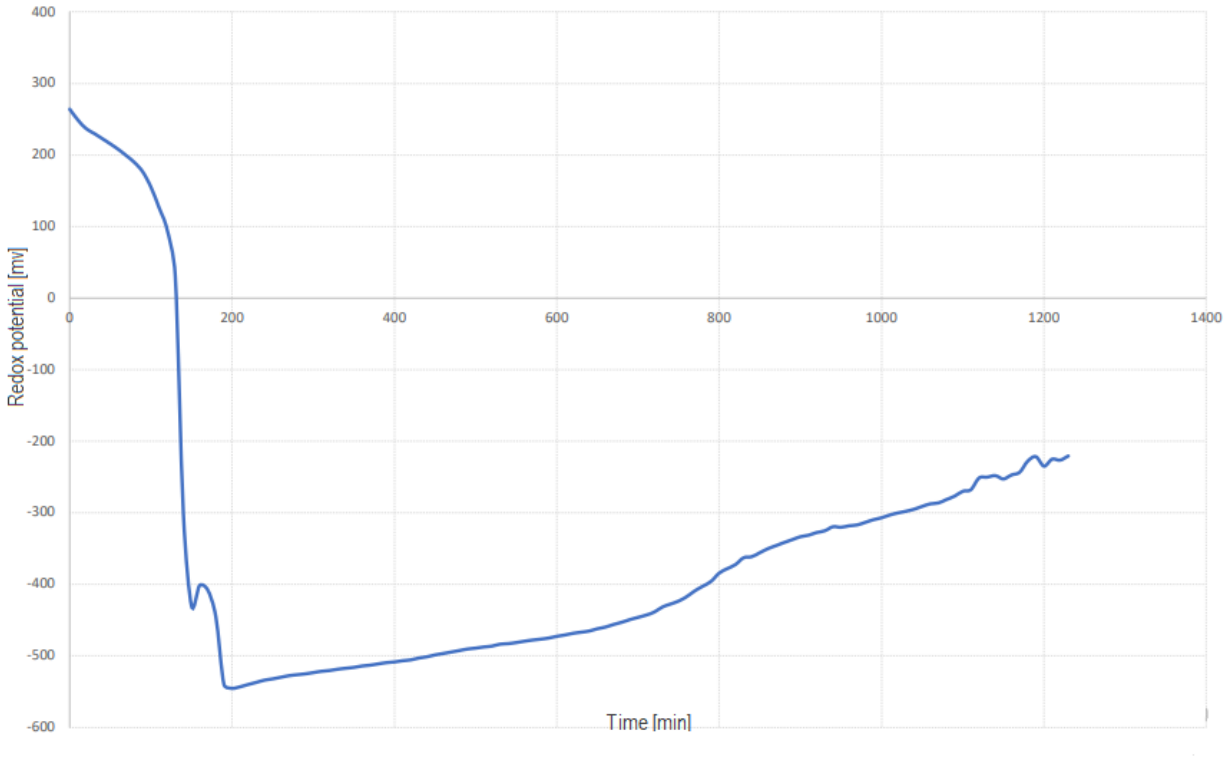

Fig. 1. *Redox potential curve of E. coli.*

Redox potential measurements

For the measurements, a system composed of multiple channels related to the electrodes is adopted (Engelhardt et al., 2018). This system is controlled with a computer and monitored with a special software that determine the redox curve and it automatically detects the TTD value from the curve. in addition to this system other instruments are needed as the water bath thermostat and test cells tubes (Reichart et al., 2007). Before the beginning of every measurement, the electrodes must be disinfected by a 3% H2O2 solution and then it should be rinsed by 70% ethanol. After disinfection the electrode can be immersed into the inoculated test tubes which are going to be put in the water bath. after connecting the electrodes with the collector, the analyses could start. (Erdosi et al.,2012; Brasca et al., 2007).

Comparing redox potential and the conventional methods

Edorosi (2012) has found in his study that there is no significant difference in the microbial count of a swab between the conventional technique and redox potential technique he also compered the required time for the determination of the total count of microbes and he noticed that redox potential measurement has been the less consuming time method, it only requires from 4 to 16 hours against 3 days by the conventional method. Reichart (2007) has detected that this alternative measurement has revelled a good repeatability and it can count microbes directly from the swab without a need for a previous washing of microbes or doing dilutions. The table below recapitulate the advantages and the drawbacks of both methods (Erdosi et al.,2012; Reichart et al., 2007).

Table 1 Comparative table between the Standard colony counting method and Redox-potential measurement (Erdosi et al.,2012; Jasson et al., 2010; Reichart et al., 2007).

Method	**Standard colony counting method**	**Redox-potential measurement**
Time consuming	24h -72h	4h-16h
Dilutions	Needs a series of dilution	No need of a dilution series*
Reproducibility	Good	Good
Repeatability	Good	Good
Selectivity	Good	Good
Specific fluids	Does not require specific fluids	Does not require specific fluids
Instruments	Needs a lot of tools	Can be reduced

*a series of dilution can be needed for the preparation of the calibration curve.

Use of redox potential measurement to differentiate species of bacteria

Redox potential measurement could be a fabulous technique to differentiate between species of microorganisms (Brasca et al., 2007; Reichart et al., 2007). According to the shape of redox potential curves, we could be able to recognize the specie of bacteria. For example, Brasca (2007) studied the possibility of discriminating among lactic acid bacteria using redox potential technique. This study required the use of 88 strains of lactic acid bacteria isolated from traditional Italian cheeses which are *Enterococcus faecalis, Enterococcus faecium, Enterococcus durans, Streptococcus thermophilus, Lactococcus lactis ssp. lactis, Lactobacillus paracasei ssp. paracasei, Lactobacillus plantarum, Lactobacillus delbrueckii ssp. bulgaricus, Lactobacillus helveticus and Pediococcus pentosaceus* (Brasca et al., 2007). The results of the redox measurements are recapitulated in the table below.

Table 2 Mean values of the kinetic parameters analysed from the redox levels of lactococci, lactobacilli cultured in sterilized skim milk (Brasca et al., 2007).

Species	**Eh min [mv]**	**tmin [h]**	**Δ max [mv]**	**t*[h]**
lactococci				
Enterococcus faecalis	-221.1± 13.4	2.7± 0.6	326.8± 93.1	1.1± 0.3
Enterococcus faecium	-137.7± 12.3	3.7± 3.2	141.1± 14.7	2.4± 0.9
Enterococcus durans	-120.5± 31.3	3.4± 1.7	154.3± 37.6	2.2± 0.5
Streptococcus thermophilus	7.9± 32.9	22.2± 0.8	26.5± 79.2	3.6± 0.3
Lactococcus lactis ssp. *lactis*	-162.3± 29.0	3.8± 0.6	246.6± 53.3	2.2± 0.6
Pediococcus pentosaceus	59.0± 23.5	20.3± 4.7	24.3± 8.9	5.8± 2.2
lactobacilli				
Lactobacillus delbrueckii ssp. *bulgaricus*	54.2± 20.4	15.7± 6.1	41.7± 13.1	6.0± 1.7
Lactobacillus helveticus	54.4± 23.8	13.6± 5.5	30.8± 10.5	6.4± 1.6
Lactobacillus plantarum	-153.8± 18.2	7.6± 0.6	229.5± 88.6	5.4± 0.4
Lactobacillus paracasei ssp. *paracasei*	-169.1± 13.8	7.5± 2.7	174.2± 56.2	4.2± 1.3

Δ max, maximum difference between two measures; t*, the time at which the maximum rates occurred; Eh min, the minimum value of Eh reached throughout 24 h; t min, the time corresponding to Eh min.

After the determination of the redox curves of the different species, it was noticed that redox potential is a characteristic parameter to differentiate among the species. Furthermore, it was found that there are remarkable differences even within the same species (Brasca et al., 2007).

Conclusion

It can be concluded that the evaluation of redox potential can provide a bunch of important information about the evolution of a microbiological system and the differentiation between the species. Furthermore, this technique can be a good alternative to inspect on hygiene indicators, and to guarantee the microbiological quality of food products. However, more research should be done to precisely understand and detect the unique shape of redox potential curves of every type of microorganism.

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AGRONOMIC PERFOMANCE OF DOUBLED HAPLOID RICE BREEDING LINES IN A SMALL SCALE PADDY EXPERIMENT

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Abstract

Successful integration of the *in vitro* haploid induction into the traditional pedigree breeding program is a key element of the Hungarian rice varietal improvement nowadays. Since Hungary is a temperate country characterized by often unfavorable climatic- and marginal soil conditions, successful rice genotypes need to have short duration, earliness, good tolerance to cold and salt stress in all developmental stages and photoperiod insensitivity.

Three different crosses in F_2 and F_6 generations were used to produce doubled haploid (DH) plants. Preselected DH_2 lines were tested for agronomic performance in a small scale experiment under traditional paddy conditions. Significant differences were found among the yield data of the selected lines. Eight DH_2 were found to be superior to the check varieties. Agronomic selection was performed during the growing season based on early vegetative vigor, cold tolerance, blast resistance, earliness, plant habit, panicle form and commercial quality parameters. Based on these results, 'Tünde 14.VII', '1009/1/17', '1009/1/12', 'Karola 11.I.', 'Karola 11.I/3.' and 'Karola 11. I/1' were selected for further evaluation studies.

Keywords: *Oryza sativa* L., androgenesis, anther culture, doubled haploid, agronomic traits

1. Introduction

Hungary is one of the northernmost rice growing countries in Europe, so successful rice varieties need to be characterized by short duration, earliness, good tolerance to cold stress in all developmental stages and photoperiod insensitivity (Jancsó et al., 2017; Simonné Kiss, 2001; Székely et al., 2022). The climate and the marginal soil conditions of the paddy fields provide excellent opportunities to select abiotic stress tolerant genotypes.

Since one hundred years ago (Blakeslee et al., 1922), haploids are important tools for the genetics and breeding because of the production of homozygous plants (Bajaj, 1990) in many crop species (Barnabás et al., 2005; Broughton et al., 2014; Lantos et al., 2018, 2005; Lantos and Pauk, 2021). The main advantage of doubled haploid plant production methods is the development of genetically homozygous lines in one generation and thus crop improvement programs (Pauk et al., 2009) and plant physiological experiments (Nagy et al., 2017) can focus on stable lines.

The first report on successful *in vitro* haploid induction in anther culture of rice (*Oryza sativa* L.) was published by Niizeki and Oono from Japan (Niizeki and Oono, 1968). In Hungary, a rice variety, named 'Dama' (HSC-2) was the first plant variety that was state released with biotechnological origin in 1992 (Heszky et al., 1996; Heszky and Simon-Kiss, 1992). In the last 30-years, more rice varieties ('Janka', 'Risabell', 'Ábel') were registered after the successful integration of the *in vitro* haploid induction into the traditional pedigree breeding program (Pauk et al., 2009).

This paper summarizes the results of a small-scale field experiment of doubled haploid (DH) lines in DH_2 generation. The experiment was set up as part of a breeding program with the aim to select new promising rice genotypes and to increase the competitiveness of the rice farmers in the region.

2. Materials and methods

Anther-derived DH rice lines were produced in the laboratory of the Cereal Research Non-Profit Ltd. (Szeged, Hungary). Three different crosses in F_2 and F_6 offspring generations were used ('1009'F_2, 'Tünde'F_6 and 'Karola'F_6).

Populations are derived by the crossing of the following parental genotypes as Köröstáj 333/Nembo, HSC-2/GB2005 and Graldo/M-71//HSC-2, respectively. After successful acclimatization to field conditions, DH_0 generation was raised in the paddy fields of the MATE ÖVKI Rice Research Station (Szarvas, Hungary). As this experiment was part of a research and breeding program, we selected the most productive DH_1 lines for further evaluation by basic agronomic traits (plant habit, plant height, lodging resistance, blast resistance and basic grain quality parameters).

In the present experiment, 12 preselected DH_2 lines were evaluated in a randomized small-plot field experiment (n=3). Three state released and widely grown Hungarian rice varieties ('M 488', 'M 225' and 'Janka') were used as check varieties. Sowing was performed by a plot seeder (Plotseed TC, Wintersteiger AG, Austria) on the 8th of May, 2018. Plot size was 3.6 m^2. Standard agronomic management practice was used to maintain uniform crop development (pre- (Pendimethalin) and post-emergence (Penoxsulam) herbicides, paddy conditions, split application of 120 kg/ha N in urea fertilizer, no fungicide). Harvest was done by hand on the 3rd of October, 2018. Meteorological data were collected by using an Agromet Solar automatic weather station (Boreas Ltd., Hungary) next to the experimental field during the growing season (Table 1).

Basic mathematical analysis was done by using of MS Excel. Statistical analysis was performed with IBM SPSS Statistics 22 software using One-Way ANOVA with the Tukey post hoc test ($p=0.05$)

Table 1. Monthly weather data during the rice growing season in 2018 (Szarvas, Hungary)

Month	Precipitation (mm)	T avg. [a] (°C)	T min. (°C)	T max. (°C)
April	11.2	16.4	4.9	29.7
May	37.4	20.1	10.0	31.2
June	31.0	21.4	8.0	32.8
July	69.8	22.8	8.3	33.3
August	43.9	24.4	13.6	35.2
September	14.5	18.4	2.5	33.2
October	10.6	13.6	1.2	25.5

[a] Air temperature was measured by an automatic weather station at 2 m height every 10-minutes

3. Results and discussion

A small-scale field experiment of DH_2 lines was performed to compare the agronomic performance to the local check varieties. The growing season was suitable for the rice production with a warm and rainy weather in May (Table 1). No serious weather extremities were recognized except high daily temperatures during the flowering season until the first decade of August. The higher precipitation in July and August allow us to perform *in situ* selection for blast tolerance.

Based on phenotypic performance, each of tested DH lines was uniform in DH_2 generation. Beside other selection criteria, grain yield is one of the most important factors for new promising lines to be acceptable by the Hungarian state registration office (NÉBIH) and farmers. Our results show that eight lines were found superior to the mean yield (6640.4 kg/ha) of the local check varieties. Five of them had even higher yield than the best check variety 'M 225'. The high yield above 8 t/ha is outstanding in Hungary. The best line, 'Karola 11. I/1' reached 8872.2 kg/ha of average yield. Agronomic selection was performed during the growing season based on early vegetative vigor, cold tolerance, blast resistance, earliness, plant habit, panicle form and commercial quality parameters. Based on this complex evaluation (data not shown), six DH_2 ('Tünde 14.VII', '1009/1/17', '1009/1/12', 'Karola 11.I.', 'Karola 11.I/3.' and 'Karola 11. I/1') were selected for further evaluation studies. According to Székely et al. (2022) and Simonné Kiss (2001), these genotypes have the potential to grow successful in our temperate country where usually multiple stressors are occurring.

Table 1. Agronomic performance of DH_2 lines in a small-scale paddy field experiment (n=3). Results are compared to local check varieties as percentage of the mean yield of checks. Selection for further evaluation was done by important agronomic traits in 2018 (Szarvas, Hungary)

Genotype	Average yield [1]	Min	Max	Percentage of check mean	Selection by agronomic traits [2]
	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}	%	

'Janka' check	5597.2 a	5027.8	6444.4	84.3	n.a.
Tünde 19.II/1	5663.0 a	4611.1	6200.0	85.3	-
Tünde 14.VIII/1	6290.7 ab	5877.8	6722.2	94.7	+
Tünde 14.I/1	6437.1 ab	5877.8	7266.7	96.9	-
Tünde 17. I/1	6659.3 ab	6016.7	7500.0	100.3	+ + +
Tünde 14.VII	6864.8 ab	6244.4	7205.6	103.4	+
'M488' check	7037.0 ab	6875.0	7291.7	106.0	n.a.
Tünde 19.III.	7053.7 ab	6483.3	7355.6	106.2	-
Tünde 17.II.	7233.3 ab	6400.0	8805.6	108.9	-
'M225' check	7287.0 ab	7027.8	7750.0	109.7	n.a.
1009/1/17	8470.4 ab	7383.3	10227.8	127.6	+ + +
1009/1/12	8644.4 b	6988.9	10961.1	130.2	+ +
Karola 11.I.	8688.9 b	8500.0	9222.2	130.8	+ +
Karola 11.I/3.	8835.2 b	8505.6	9094.4	133.1	+ + +
Karola 11. I/1	8872.2 b	7988.9	9238.9	133.6	+ + +
Mean of check varieties	6640.4	5027.8	7750.0	100.0	n.a.

[1] Average yield of DH2 lines (n=3) in a randomized small-scale experiment (3.6 m^{-2} per repetition), statistical analysis was done with IBM SPSS Statistics 22 software using One-Way ANOVA with a post hoc test of Tukey (p=0.05)

[2] Agronomical selection of the DH2 lines was performed during the growing season based on early vegetative vigour, cold tolerance, blast resistance, earliness, plant habit, panicle form and commercial quality parameters. Legend: - = negative selection, + = positive selection, n.a. = not applicable

4. Conclusion

Doubled haploid plant production methods are important tools in breeding and research projects since development of genetically homozygous lines is achievable in one generation. The rapid generation advance let us save resources and answer to challenges earlier. Research on DH rice production started in Hungary more than 40 years ago and several varieties were released since the '90s. The improvement of DH production is continuous and the improved anther culture technology let us produce several hundreds of DH plants from *O. japonica* every year. In the present study, 12 preselected DH_2 lines were evaluated in a randomized small-plot field experiment for agronomic traits (first of all for yield performance). Based on our results, six genotypes were selected for further evaluation studies which can help us to increase the competitiveness of the Hungarian rice breeding and the rice production sector.

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EVALUATION OF ARSENIC CONTENT OF FOUR TEMPERATE JAPONICA RICE VARIETIES IN A GREENHOUSE EXPERIMENT

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Abstract

The arsenic content of the rice seeds usually much higher than of other cereals because of the anaerobic circumstances of the cultivation. A greenhouse pot experiment was performed to evaluate the arsenic content of rice biomass under different growing conditions (aerobic and anaerobic) and the effects of humic acid treatment. Three Hungarian and one Italian rice genotypes were used to find out the genotypic differentiation of arsenic accumulation. In half of the pots humic acid was investigated to determine its impact on the arsenic accumulation. We also measured some basic agronomic traits like the average shoot numbers and the shoot weight. Significant differences were identified among varieties in these parameters. Our results showed that the As content of shoot biomass were significantly higher (3.15-6.95 mg kg^{-1}) in flooded conditions than in aerobic ones (0.19-0.27 mg kg^{-1}). However in the same treatments we did not found significant differences among the varieties. Differences between controls and humic acid treatments were also not significant regarding the arsenic accumulation.

Keywords: arsenic contamination, humic acid, irrigation treatments, rice

1. Introduction

In Hungary, rice is a special crop of agricultural production with a high percent of organic cultivation. Rice production is providing valuable food products but because of the tightening food safety regulations farmers and thus the breeders in the whole Europe are facing with an increasing need to prevent or limit arsenic accumulation of the rice plants with different methods (e.g. development of new technologies, selection of genotypes). Within the various food types, rice-based products showed the highest levels of estimated inorganic arsenic (As) (European Food Safety Authority, 2014).

Rice is mostly cultivated in flooded conditions worldwide, where the anaerobic circumstances make the arsenic uptake and transfer more accessible for plants (Takahashi et al., 2004). In reducing environments the most typical inorganic arsenic form is arsenite ((As(III)), while in aerobic soils the arsenate ((As(V)) is dominant (Xu et al., 2008; Zhao et al., 2009). The As(III) can easily get into the soil solution by reductive dissolution of iron compounds. Therefore the As(III) is more mobile than the As(V) (Takahashi et al., 2004). Flooding the paddy soils leads to increase As bioavailability to rice plants (Williams et al., 2007; Xu et al., 2008). Rice roots can uptake the As(III) and some organic arsenic forms (monomethyl arsenic acid (MMA) and dimethyl arsenic acid (DMA) through aquaporin pathways, like Nodulin 26-like Intrinsic Proteins (NIP) that are silicon transporters (Li et al., 2009).

Several research reported that in aerobic environments the arsenic concentration of rice shoot and grain strongly reduced (Norton et al., 2012; Xu et al., 2008). Therefore one of the effective methods of reducing As content of rice can be the periodically dried paddy field (Hu et al., 2013).

According to Yu et al. 2018, the humic components can inhibit the Cd uptake in rice by reducing mobility and bio-accessibility of Cd in soil (Yu et al., 2018). In study of Malik and Azam (1985) positive effects of humic acid (HA) on wheat growth in seedling stage were determined. They found increasing root length and fresh and dry weight of root due to the HA (Malik & Azam, 1985). Significant effects of HA on the rice root system were reported in Tavares et al. (2021) research. During the seedling stage mainly the diameter of root hairs and root collars were highly stimulated by HA (Tavares et al., 2021). Fu et al. (2011) examined the contents of arsenic in 282 brown rice samples connected with considered soil properties. The results showed that the correlation between As concentration of grain

and soil properties were significant in case of soil arsenic speciation, organic matter and soil P contents. They considered that the HA bound and Fe-Mn oxides bound As in the paddy soils could be the most important indicator for potential As uptake by rice (Fu et al., 2011).

Our aims were to determine basic agronomic traits (average shoot number and shoot weight) and the As content in straw of different temperate japonica rice varieties in anaerobic and aerobic conditions and to analyze the correlation between As concentration and the HA content of the soil.

2. Materials and methods

Four temperate japonica rice genotypes (’Janka’, ’M 488’, ’SZV Szellő’, ‘Nembo’) were used for the evaluation of arsenic uptake under different conditions. The experiment was performed at the Rice Research Station of the Hungarian University of Agriculture and Life Sciences in Szarvas, in 2020.

The treatments were as follows with four replications:

1. Flood irrigation (FC – Flooded Control)
2. Flood irrigation with Humin Power G soil conditioner (FH)
3. Aerobic condition (AC – Aerobic Control)
4. Aerobic condition with Humin Power G soil conditioner (AH)

Table 1. Chemical parameters of the soil from local paddy field that was filled into the experimental pots (2020)

Soil parameters	Values
pH (KCl)	6.92
Total soluble salts (m/m% dw)	0.05
Humus (m/m% dw)	2.67
Carbonated lime (m/m% dw)	<0.5
Nitrate+nitrite N (KCl) (mg/kg dw)	2.39
Phosphorus (mg/kg dw)	409.0
Potassium (mg/kg dw)	490.0
Magnesium (mg/kg dw)	533.0
Arsenic (HNO_3/H_2O_2) (mg/kg dw)	10.6

Table 2. Analysis of main parameters of the Humin Power G soil conditioner

Humin Power G parameters	Values
pH (H_2O) (m/m% dw)	8.08
Humic acid (m/m% dw)	75.0
Nitrate+nitrite N (KCl)(m/m% dw)	0.6
Phosphorus (m/m% dw)	10.0
Potassium (m/m% dw)	5.0
Magnesium (m/m% dw)	4.0

Before sowing 16 pieces of 90 liter plastic pots were filled with 50 kilograms of soil from the paddy field of the Research Station (Table 1). Humin Power G soil conditioner (Fertechnic Ltd., Gödöllő) was added to 8 pots with the dose of 12g per pot according to the farm recommendation (Table 2). The sowing was carried out on the 24th of April, 2020. Five rows were sowed in every pots, 3 varieties in 1-1 row, and 1 variety in 2 rows in a randomized way. Therefore five repetitions were analyzed per each variety. During the growing season 8 pots were flooded from 18th of May to ensure the anaerobic condition and 8 pots were left in aerobic circumstances, irrigated with tap water to 60% of the field capacity of the soil. On the 22nd of June 2.5g urea fertilizer ($CO(NH_2)_2$, 46% N) was applied in each pot.

Panicles of the plants were harvested on 13-14th August except 'Nembo' which was collected on September 3. The different harvesting time was based on the longer growth duration of 'Nembo'. Total shoot biomass were collected and measured on 22nd of September. The above ground biomass (stems and leaves) were analysed in 5 replications. Same time with the biomass harvesting, the number of shoots/plant were counted and measured. The mean shoot weight was calculated by dividing plant weight by the shoot number. The arsenic contents of the shoots were analysed by ICP-OES.

Basic mathematical analyses were calculated using Microsoft Excel. The collected data were subjected to the analysis of variance (ANOVA) using IBM SPSS Statistics software (version 22.0).

3. Results

3.1 Average shoot number of a rice plant and average weight of a rice shoot

We found significant differences among varieties in the number of shoots/plant and in the mean shoot weight traits too as shown in the table 3. However the number of shoots as well as the shoot weights were quite stable within the genotypes, no significant differences were found among the treatments.

The variety 'Nembo' had the lowest number of shoots in all treatments. The differences were significant in all cases except in FH, where 'SZV Szellő' (2.71±1.24 pcs) did not show significant difference from 'Nembo' (2.00±0.99 pcs). In aerobic conditions (AH), the highest values were found in 'Janka', 'M 488' and 'Nembo' (3.86±1.47, 3.53±1.05 and 2.32±0.84 pcs, respectively). 'SZV Szellő' showed similar shoot number in AC and in AH (3.67±1.52 and 3.64±2.03 pcs, respectively).

The average weights of shoots can be divided into three groups. Significantly lowest shoot weights were measured in 'M 488' and 'SZV Szellő' in each treatment. The second group includes 'Janka', its values showed significant differences from all the other examined varieties. The average shoot weight of the 'Nembo' was the highest as the third group. The average shoot weight of this variety was significantly higher in anaerobic conditions than in aerobic ones (FC: 3.65±0.76, FH: 3.29±0.84, AC: 2.55±0.57, AH: 2.65±0.61 g).

Table 3. Average shoot number per rice plants and mean weight of shoots in case of four examined varieties. Different letters show the significant differences among varieties in the same treatment at level 0.05.

Treat.*	Variety	N	Shoot/plant pc.	Average shoot weight g	Treat.*	Variety	N	Shoot/plant pc.	Average shoot weight g
FC	Nembo	39	2.18^{a}	3.65^{c}	AC	Nembo	35	2.29^{a}	2.55^{c}
	M 488	51	2.88^{b}	1.31^{a}		M 488	46	3.26^{b}	1.14^{a}
	Janka	50	2.90^{b}	1.74^{b}		Janka	51	3.67^{b}	1.69^{b}
	SZV Szellő	44	3.43^{b}	1.43^{a}		SZV Szellő	42	3.67^{b}	1.31^{a}
FH	Nembo	38	2.00^{a}	3.29^{c}	AH	Nembo	34	2.32^{a}	2.65^{c}
	M 488	48	3.27^{b}	1.34^{a}		M 488	51	3.53^{b}	1.21^{a}
	Janka	48	2.96^{b}	1.74^{b}		Janka	49	3.86^{b}	1.92^{b}
	SZV Szellő	51	2.71^{ab}	1.45^{a}		SZV Szellő	45	3.64^{b}	1.23^{a}

* Treatments in the experiment: FC - Flood irrigation, FH - Flood irrigation with Humin Power G soil conditioner, AC - Aerobic condition, AH - Aerobic condition with Humin Power G soil conditioner

3.2 Arsenic content of the shoot biomass

The arsenic concentration of the above ground biomass was significantly higher in flooded than in aerobic conditions (Figure 1). However, significant differences were found nor between FC and FH neither AC and AH. Both in FC and in FA treatments the As-content in the biomass of 'M 488' was the highest (6.95±2.16 and 6.71±0.92 mg kg^{-1}, respectively) and in the case of 'Nembo' was the lowest (3.25±0.78 and 3.15±0.67 mg kg^{-1}, respectively). However the difference between 'M 488' and 'Nembo' was only significant in the FH treatment. The values of 'Janka' and 'SZV Szellő' were between the other two genotypes' values.

No significant differences were recognized among the varieties in aerobic conditions. In both AC and AH the highest As-concentration was measured in the biomass of 'SZV Szellő' (0.27±0.11 and 0.24±0.06 mg kg^{-1},

respectively). In AC the values of 'Janka' were the lowest (0.19±0.05 mg kg^{-1}), while in AH treatment the 'Nembo' showed the lowest mean value (0.19±0.06 mg kg^{-1}).

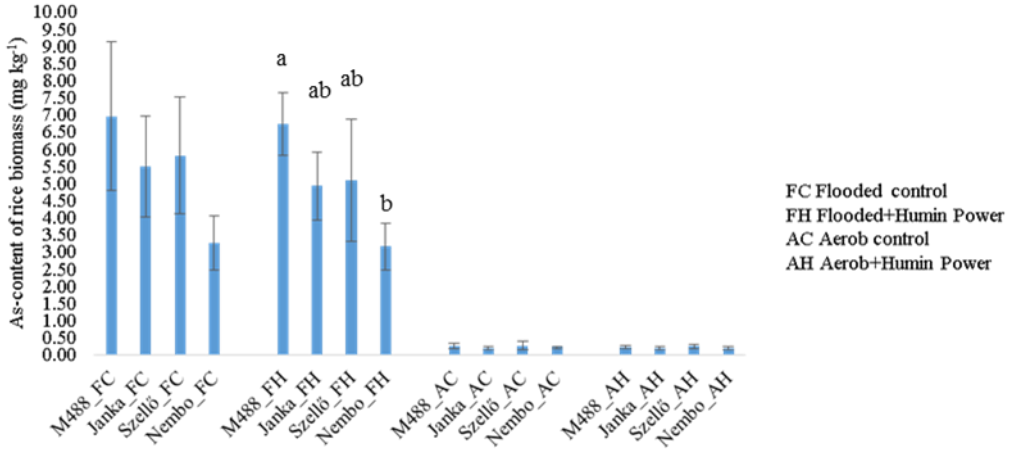

Figure 1. *Arsenic concentration of shoot biomass of four temperate japonica rice varieties in anaerobic (FC, FH) and aerobic (AC, AH) conditions of a greenhouse pot experiment (Szarvas, 2020) Different letters mean significant differences among the examined varieties at level 0.05*

4. Conclusions

The cultivation technology has a great effect on arsenic accumulation of rice. The flood irrigation caused much higher arsenic concentration in shoot biomass because of the anaerobic conditions. We did not found any effect of humic acid on the As content of the rice shoot, as well as the other examined parameters. To realize the impact of humic acid, should be examined other morphological, physiological and chemical parameters, and field experiment should be set up for further findings.

The mean shoot number of a single plant varied less among the treatments as well as among the varieties, although the Italian variety showed significantly lower values. Comparing the average weight of a shoots there were higher differences among the genotypes, however within the varieties was not determined significant differences despite of the different circumstances and treatments. It is considered that these phenomena may also regulated by genes beside external conditions.

To find out more about the arsenic uptake of the rice further examinations are needed (e.g. investigation on the arsenic concentration of the rice roots).

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Influence of three types of feeding Termites, Earthworm and Commercial Feed on the Growth and Flesh Quality of African Catfish (*Clarias gariepinus)*

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Abstract

All together 240 fingerlings of *Clarias gariepinus* were put into the experiment for 90 days in aquaculture facility at the Faculty of Agriculture of National University of Laos. Three different types of feeding earthworm (EW); termite (TM) and commercial feed (CF), were offered as diet to three groups, each in four replications. Fish were fed daily at 3% of their body weight.

Composition of particular feed were: i) EW - 32.63% crude protein (CP), 9.79% fat content (FC); ii) TM - 37.05% CP, 6.05% FC; iii) CF - 30.00% CP, 4.00% FC. The averages of fish weight at the end of the experiment were recorded as follows: i). Fish fed by EW 336.26 g/fish, (3.47 g*day^{-1}); ii) Fish fed by TM 339.30 g/fish (3.50 g*day^{-1}); and iii) Fish fed for CF 322.01g/fish (3.31 g*day^{-1}). There was non significant deference (P >0.05) among the weight recorded for fish fed by different experimental diets. The body flesh quality of African catfish fed by three different feeds showed that the protein in fish fed by TM (52.92%) was significantly the highest (P < 0.05). Fish fed by CF diet rich only 47.01% and by EW 50.91%. In contrast lipids content of fish fed by termite were no significantly (P > 0.05) lower 12.57% than lipids content of fish fed by CF diet in 16.99% and EW diet in 12.92%.

Key words: Catfish "*Clarias gariepinus*", growth, earthworms, termites, commercial feed and fish muscle.

I. Background

Presently aquaculture in the main an important economic sector in Laos and contributes more half of the animal protein to the human population. However, the overall importance of captured fish from rivers has declined, due to serious environmental and social issues (FAO, 2008). The economic outlook for Lao PDR remains favorable, but rising inflation poses a risk, and has been climbing from 4.5 % in 2007 to approximately 6.5 % in January 2008. Food security at household level derives principally from forestry, livestock and fisheries, with freshwater fish being the principal source of animal protein for the rural population. Surveys carried out by the MRC Fisheries Program suggest that, in Lao PDR and Cambodia, the consumption of traditionally dried and fermented fish products alone amounts to 10 to 14 kg/head/yr (FAO, 2006). Consumption of fish and aquatic products was estimated to be between 13-48 kg/capita/yr, representing between 22 to 55 % of animal product consumption (Funge-Smith and Dubeau, 2002). The Government of Lao PDR is endeavoring to increase the annual fish consumption to 23 kg per capita by year 2010 (MAF, 2005). The gap between supply and demand must be met by aquaculture related developments, which are still in their infancy and currently account for less than 250 tones per year (MRC, 2007). In addition to fish, rural Lao people eat many other aquatic resources such as eels, frogs, tadpoles, crabs, insects and shrimps, and many of these are foraged from water bodies and make up a considerable part of their daily diet. Increases in demand for animal protein are likely to occur throughout Laos over the coming decade because of the increasing population (Phonekhampheng, 2008). In addition to protein and essential amino acids, and fat and essential fatty acids, fish are an important source of thiamine and riboflavin of the vitamin B complex. The health and nutritional status of young children and lactating women could be enhanced through more regular consumption of fish (FAO, 1998). Aquaculture is making a significant contribution to improving livelihoods and alleviating poverty, and can in addition play a social role, as it may contribute in maintaining populations in their native places (Phonekhampheng, 2008). Production systems for culture of African catfish will vary with the geographical conditions and the investment capacity of the farmer. Based on the intensity of the production, the production systems used for fish culturing in general can be classified as extensive, semi-intensive and intensive (Ravagnan, 1978; FAO, 1998). The African catfish (*Clarias gariepinus)* is appreciated by consumers for the quality of its meat. In addition, the species shows a fast growth rate, tolerates adverse environmental condition far better than the other fishes do, and can use atmospheric air to breathe (Pruzyński, 2003). *C. gariepinus* or catfish is a slow-moving omnivorous predatory fish which feeds on a variety of food items from microscopic zooplankton to fish half of its length or 10% of its own body weight. The amount needed for its consumption was increase when its body weight increasing. Thus, seeking for the appropriate feed formulation for feeding catfish is a good solution for catfish raising (Phonekhampheng, 2008; Bui Xuan Men et al., 2005). But the cost of feeding is an important component of fish farming. By this study the cost could be estimated for fish raising by using natural feed such as termites and earthworms compared with commercial feed. These organic feeds exist in the nature and farmers can find or raise earthworms by themselves. The result of this study can be used for promoting farmers in the rural area.

II. Problem Statement

- What are the effects of feeding on the growth performance of African catfish fed by termites, earthworm and commercial feed**?**
- How is the flesh quality of African catfish fed by these three above different diet?

Laos although has been an agriculture country that more than 70% of population work on agriculture. The agriculture technology has very slowly grown. Industrial sector to support agriculture was very limited especially animal feed industrial. Thus, most of animal feeds for chicken, pig, fish and cattle are imported from neighboring countries. The prices were higher than neighboring countries. This cause to the prices of agriculture products in Laos has increased depending on raising price of animal feed from neighboring countries and increase the input cost for smallholder farmers. Catfish was one of the important agriculture products for ensuring food security in the household level. The framers' fish culture for consumption and generate income. The farmers have high impact when the prices of catfish feed increase. Thus, this study would like to minimize the input cost for raising catfish in order to help smallholder farming for food security and income generation.

III. The objectives

1) To investigate on the growth performance of African catfish fed by termites, earth-worm and commercial feed.
2) To study on the flesh quality of African catfish fed by these three above different diet.

IV. Materials and methodology

4.1. Location

The experiment will be carried out at farm of Department of Livestock and Fishery, Faculty of Agriculture (Nabong campus), National University of Laos, 32 km from Vientiane center to Campus.

4.2. Experimental treatments

The total number of 240 specimens of African catfish fingerlings will be selected to conduct the experiment, 20 fingerlings fish per cement tank. The age of catfish on the beginning of the try will be 30 days after hatching. The fingerlings will be evaluated in terms of health and injury symptoms. The African catfish will be raised in the cement tanks and there are 4 replications in 3 treatment allocated in Completely Randomize Design (CRD). So the concrete circular tanks of the size of 1 m diameter and 0.5 m depth,
The treatments are:

EW : Earthworms

TM : Natural Termites

CF : Commercial feed

No of fish	EW	TM	CF
Replication 1	20	20	20
Replication 2	20	20	20
Replication 3	20	20	20
Replication 4	20	20	20

4.3. Feed and feeding

The diet will be divided into EW, TM, and CF. The commercial feed will be purchased from the local market. The earthworm the species of *Perionyx excavates* was cultivated by using cattle and goats manure and termites will be collected from the nearly forest and soil.

4.4. Feeding management

After 30 days of hatching, African catfish will be moved from the nursery ponds to the concrete tanks for 15 days adaptation before starting data collecting. The diet of earthworms, natural termites and commercial feed will be offered four times per day to fish at 3 % of body weight per day (Goda *et al.*, 2007). The feeding frequency was two times per day at 6:30 am and 16:30 pm

4.5. The measurement, samples collection and analysis of data

The fish will be weighed before the experiment. The every 15 days from weight begin to the end of the experiment by random sampling 40% of all fish per replication (Nyina-Wamwize *et al.*, 2007). The weighing will be always in the morning before feeding starts (6:00 am).

a) Calculation of Weight, length measurement

The calculation and measurements will follow Konyene *et al.*, (2006) and Goda *et al*., (2007).

- Mean weight gain (g/fish) = $(W_f - W_i) / n$
- Average Daily Gain (ADG) (g/day) = Weight gain / day
- Food Conversion Ratio = Feed intake (g) / Fish weight gain (g).
- Mean Length gain (cm/fish) = $(L_f - L_i) / n$

W_f= final body weight

W_i= Initial body weight

n = number of all fish

b) Calculation samples of data analyze

The end of the experiment in the samples of fish from each replication will be analyzed for the percentage of dry matter, crude protein, fat and ash (Undersander *et al.*, 1993; AOAC., 1990).

4.6. Statistical analysis

The obtained data will be analyzed using by the SPSSS option of the IBM SPSS software program by version 24.0 in Kon Kaene University. All of the statistical tests were conducted at 95% confidence level by *p-value* < 0.05.

V. Result

5.1. Growth performance of African catfish

Table2. Growth performance and body (weight and length) of African catfish fingerlings fed diet. (90 day growth period)

Parameter	Average of African catfish			CV	P-valu
	EW	TM	CF		
Initial weight (g/fish)	24.00	24.01	24.01	-	-
Final Weight (g/fish)	336.26	339.30	322.01	9.710	0.729
Initial Length (Cm/fish)	15.79	15.63	15.72	-	-
Final Length (Cm/fish)	34.87	35.27	34.46	2.496	0.459
Mean Weight Gain (g/fish)	312.26	315.29	298.00	10.467	0.792
Mean Length Gain (Cm/fish)	19.08	19.64	18.74	5.107	0.452
Daily Feed intake (g $fish^{-1}$ day^{-1})	3.04	3.07	2.98	-	-
Average daily gain (g/day)	3.47	3.50	3.31	10.481	0.727
Feed conversion ratio (FCR)	0.88	0.88	0.90	7.325	0.878

There were no differences (P > 0.05) in growth performance of African catfish fingerling, expressed as final weight of them such as TM, EW and CF into 339.30 g/fish, 336.26 g/fish and 322.01 g/fish respectively of P-value = 0.729, the expressed as final length of TM, CF and EW into 35.27 cm/fish, 34.87 cm/fish and 34.64 cm/fish respectively (P-valu = 0.459), after then both mean weight gain (MWG) and mean length gain (LWG) were no differences (P > 0.05) between diets. Expressed as the average daily gain (ADG) was similar (P > 0.05). Moreover, feed utilization, expressed as the feed conversion ratio (FCR) was similar again (P > 0.05) between diet. However, all these differences were not significantly different in showing at the table 2.

5.2. Analyzed chemical composition of African catfish (Clarias gariepinus)

The African catfish in each concrete circular tank were analysed in laboratory in terms of the chemical characteristics for found flesh quality of catfish in showing at the table 3.

Table 3. Chemical composition of African catfish (*Clarias gariepinus*) Analysis

Body composition	Catfish (*Clarias gariepinus*)	P-valu	CV

(% DM)	EW	TM	CF		
DM	20.25	21.25	22.25	0.357	6.152
Protein	50.91 [a]	52.92 [a]	47.01[b]	0.017*	4.656
Ash	2.38	4.00	3.00	0.171	5.375
Lipid	12.92	12.57	16.99	0.086	19.214

[a,b,c] Means within rows with different superscripts differ significantly (P<0.05)

* Pooled standard error of significantly different 95%.

Both DM % and Ash %, There were no treatment differences or not significantly different (P > 0.05) in whole body dry matter basis content of CF, TM and EW into 22.25%, 21.25% and 20.25% respectively (Table 18); Ash in chemical composition on fresh weight basis content of CF, EW, TM into 3.00%, 2.38% and 4.00% respectively. However, body crude protein content were significantly different (P < 0.05) in fish fed diets 50.91% of EW; 52.92 % of TM and 47.01 % of CF in crude protein (Table 18). And (EE) lipid content in 16.99 % of CF, 12.92% of EW and 12.57 % of TM there were no treatment differences (P > 0.05) when comparatives of three feeds on growth of catfish feeding CF was highest both EW and TM in respectively of fat contain.

VI. Discussion

There is no significant difference (P > 0.05) between the growths of fingerling fed by diets composed of earthworms, termites and commercial feed. When the comparatives during the growth rate of *Clarias gariepinus* on the diets termites were higher more than diets earthworm and lower commercial feed in mean weight gain 315.29 g/fish, 312.26 g/fish and 298.00 g/fish respectively. And from average daily gain of three different feed in the experiment were no significant difference (P > 0.05); The growth rate of African catfish *Clarias gariepinus* on the diet only earthworms (3.04 g/day) were higher than was report for catfish (0.69 g/day) given diets containing rice bran (60%), trash fish (10%) and earthworms (30%) Tram *et al*., (2005) of average daily gain (ADG = 0.67 g/day) was lower than in presented study in average daily gain (ADG) 3.47 g/day. And from feed diet of only termites (3.07 g/day) was lower than report by Nyina-wamwiza *et al.*, (2007) for given diet termites 3 "50%" (TM3; 50%) 4.87 g/fish; in recorded feed conversion ratio (FCR = 0.88) for catfish were better than reported by Nyina-wamwiza *et al.*, (2007) in FCR = 2.88. when comparison of the experiment of three different feed earthworms, termites and commercial feed there are no significant difference (P > 0.05) of feed conversion ratio 0.88; 0.88 and 0.90 respectively.

Body composition remained unchanged by all the dietary treatments, with the exception of reduced crude protein content in the diet of the earthworms, termites and commercial feed there are significant difference (P < 0.05) in crude protein of fish fed by termite (TM) 52.92 %, in crude protein of fish fed by earthworm (EW) 50.91% and in crude protein of fish fed by commercial feed (CF) 47.01 %. When this could body composition of protein content was higher than it was found by Nyina-wamwiza *et al.*, (2007). Body moisture content or dry matter (DM) was comparable to previously report value (Degani *et al*., 1989), while ash content was lower than (Phonekhampheng *et al*., 2008b) but from analysis of fish by feeding three different feed there are no significant difference (P > 0.05) in ash of fish fed by termite (TM) 4.00 %, in ash of fish fed by earthworm (EW) 2.38 % and in ash of fish fed by commercial feed (CF) 3.00 %. And body lipid content was higher (Nyina-wamwiza *et al*., 2007; Phonekhampheng *et al*., 2008a) but there were also no significant difference (P > 0.05) in lipid of fish fed by termite (TM) 12.57 %, in lipid of fish fed by earthworm (EW) 12.92 % and in lipid of fish fed by commercial feed (CF) 16.99 % this the experiment; when the comparatives of lipid during three different feed was fish fed by termites (TM) there lipid content lower than earthworms (EW) and commercial feed (CF) respectively.

VII. Conclusions

In the raising African catfish in concrete circular tanks; the growth rate and feed conversion for DM was better for *Clarias garipienus*, when they were fed by termites rather than earthworms and commercial feed.

The net increase in live weight (339.30 g/fish in 90 days) on the best diet (termites) was better than diet earthworm and commercial feed in African catfish of weight 336.26 g/ fish and 322.01 g/fish after 90 days of the experiment.

The body composition was slightly changed in the body protein value of the diet termites (52.92 % in DM) that was higher than diet commercial feed (47.01 % in DM) with statistical significance (P < 0.05), while body lipid content of diet termites (12.57% in DM) was lower than diet earthworm and commercial feed (12.92% in DM and 16.99 % in DM) respectively but without statistical significance.

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Utilization of Different Level of Rice Distillers' By-Product on Feed Intake and Growth Performance of Native Pigs

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Abstract

The purpose of this study was to compare the different level of rice distiller by products on feed intake and growth performance of native pigs. A totally 12 pigs with an average initial live weight of 15 kg/h were used in experiment. There were three levels of rice distiller's by-products (RDB) as treatment: RDB10%, RDB 30% and RDB 50% in the diet. They were designed into a Completely randomized design (CRD) with replicated 3 times. The results of this study was optimized the nutrient intake at diet of RDB50% with 1.04 kg/day/h ($P<0.05$). Pig received diet of RDB 50% was also increased weight gain with 22.1 kg/head ($P>0.05$), the ADG was also improved at 399 g/day/h ($P>0.05$), which possitive effected to the FCR was better shown of 3.96 ($P<0.05$). In conclusion, varying used of RDB was linear improved growth performance of native pig.

Keywords: Rice distillers' byproduct, growing, native pig, feed conversion

Introduction

Rice distillers' byproduct (RDB) is derived as waste coproduct from traditional alcohol producing by smallholder in Laos, despite producing large scale alcohol industry surrounding the world. It contains vary protein pattern as amino acid patterns (Manh et al., 2009). It also provides a source of prebiotic as β-glucan substrate improving growth of native pig gilts (Sivilai et al., 2018) and generated other nutrients from fermented rice (Pakhira et al., 2018). Alternative use of RDB as protein sources could be help to reduce cost production (Manh et al., 2003). The apparent digestibility of RDB also confirmed in Mong cai pigs (Hong et al., 2009; Taysayaseng, et al., 2010) and small concentrate of RDB improved nitrogen retention in native pigs (Sivilai et al., 2017). Moreover, It is enhanced gut heath and growing in young pigs (Lange et al., 2015) and increased fat deposit and growth performance of pigs (Nguyen Cong et al., 2020). In this context, the optimizing use of RDB could be help to replaced expensive cost of the conventional protein feed such fish meal or soy bean meal. This is an alternative ways for smallholder farms, its use not confirm in the growing native pigs, the appropriate proportion of RDB in diets could be evidenced clearly. The objective of this research is to compare the effect of RDB in different levels on feed intake and growth performance of native pigs.

Materials and methods

Location

The experiment was carried out at Faculty of Agriculture, National University of Laos, Vientiane Capital, Lao PDR. The temperature in the area during conduct the experiment was ranged from 25-34 °C and spent time for data collection for eighty-four days.

Design and treatment

The experiment was used 12 native pigs with initial live weight at 15 kg/h and they were arranged into a Completely Randomized Design (CRD). The treatmrnt were varying different level of rice distillers' by-products (RDB) at 10%, 30% and 50% in the diet respectively.

Animal and feeding management

All of native pigs were vaccinated against hog cholera and de-wormed with Ivermectin (1 ml/20 kg LW) and adapted to the new feeds for 12 days prior to collection of data. They were fed rice bran and corn meal as energy source with consisting of wet brewers's grians by-product and ensiled taro filiage as source of protein replacement by the rice distillers' byproduct (RDB). The daily feeds were prepared immediately prior to feeding at 7:30 am and 4:30 pm; water was freely accessed through nipple tap drinkers in each pen. The rice distillers' byproduct (RDB) was bought from traditional rice wine producers, mostly smallholder farmers, in the area surrounding Vientiane city. It was stored in closed containers to maintain the quality and avoid mold growth.

Data collection and proximate analysis

The weighting pigs were performed every 14 days during the 84 days. Feeds offered and refused were recorded daily with measure the daily gain and feed conversion in each period. Representative samples were stored at -18°C until the end the experiment when they were bulked on an individual animal basis for determination of dry matter, crude protein, crude fiber and ash according to AOAC (1990) procedures.

Statistical analysis

The data of DM feed intake, live weight change and feed conversion were analyzed by the general linear model option in the ANOVA program of the Minitab software (Minitab 2016). Sources of variation in the model were rice distillers' byproduct (RDB), replicates and error.

Results

Composition of the diets

Rice distillers' byproduct (RDB) was similar fraction consisted of protein to brewers' grain by-product but lower crude fiber than ensiled taro foliage, white the rice bran and maize meal were similarly composition of crude protein and crude fiber as energy source for pigs (table 1). The experimental diets were same level of proportion of crude protein as required for native pigs (table 2).

Table 1. Chemical composition of basal diets

Diets	Chemical composition, % DM basis		
	DM	CP	CF
Ensiled taro foliage, %	14.0	16.0	19.5
Rice bran, %	85.0	7.0	15.0
Maize meal, %	85.0	8.0	5.0
Brewers' grain byproducts, %	24.0	24.0	24.1
Rice distillers' byproducts, %	16.0	23.0	3.0
Salt, %	75.0	0.0	0.0

DM: dry matter; CP: crude protein; CF: crude fiber; RDB: rice distillers' byproduct

Table 2. Ingredients of experimental diets

Diets	Chemical composition, % DM basis		
	RDB10	RDB30	RDB50
Ensiled taro foliage, %	15	10	5
Rice bran, %	15	20	28
Maize meal, %	22	18	10
Brewers' grain byproducts, %	36	20	5
Rice distillers' byproducts, %	10	30	50

Salt, %	2	2	2
DM, %	45.29	44.8	43.7
CP, %	16.15	16.14	16.26
CF, %	9.765	11.57	8.38

DM: dry matter; CP: crude protein; CF: crude fiber; RDB: rice distillers' byproduct

Dry matter feed intake

Increasing of RDB upto 50% in the diet was significantly differenced on nutrient intake of native pigs, as led to possitive effect on the DM intake following a CP was also better consumed ($p<0.05$). This was consisted pattern of true protein and more palatability ingredients in RDB confirmed in the same way (Manh et al., 2009).

Table 3. feed intake of native pig

Ingredients	Treatments, % DM basis			SEM	P-value
	RDB10	RDB30	RDB50		
DM Intake, kg/d/h	0.69^{b}	0.84^{ab}	1.04^{a}	0.077	0.029
CP intake, kg/d/h	0.11^{b}	0.14^{ab}	0.17^{a}	0.012	0.027
CF Intake, kg/d/h	0.07^{b}	0.10^{ab}	0.09^{a}	0.002	0.041
Feed Intake as %/BLW	3.78^{c}	4.31^{b}	5.29^{a}	0.012	<0.001

^{ab} Mean values without common superscript are different at $p<0.05$, DM: dry matter; CP: crude protein; CF: crude fiber; BLW: body live weight; SEM: standard error of the mean; RDB: rice distillers' byproduct

Growth rate and feed conversion

Contening of high level of protein as amino acid pattenr in RDB was trended to have increase weight gain of native pigs which lead also trended improving of daily weight gain but significantly effeced on feed conversion ratio when native pig received RDB50% in the diet. This resoult was confimed quality of protein in RDB could replace protein from ensiled taro foliage and soybean meal for native pigs with no loss in performance (Sivilai et al., 2020).

Table 4. body live weight change of native pig

Weights	Treatments, % DM basis			SEM	P-value
	RDB10	RDB30	RDB50		
DM Intake, kg/d/h	0.69^{b}	0.84^{ab}	1.04^{a}	0.020	0.029
Initial live weight, Kg/h	11.3	11.5	11.4	1.053	0.986
Final weight, Kg/h	29.0	33.0	33.5	2.930	0.518
Weight gain, Kg/h	17.8	21.5	22.1	1.947	0.279
Daily weight gain, g/h/d	212	393	399	0.023	0.279
Feed conversion ratio	3.33^{b}	3.30^{ab}	3.96^{a}	0.130	0.01

^{ab} Mean values without common superscript are different at $p<0.05$; SEM: standard error of the mean; RDB: rice distillers' byproduct

Conclusion

- A high levels of rice distillers' byproduct (RDB), RDB50% in the diet was linear increased feed intake and trended improving a growth rate but it significantly differenced on feed conversion ratio in native pig
- The using of 50% of rice distillers' byproduct (RDB) in the diet was positive effect in the fattening native pig growth but its higher proportion more than 50% of RDB could be identified for further study.
- Rice distillers' byproduct (RDB) could use as protein source to replaced other expensive feed cost for smallholder farms.

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Assessment of sustainable coffee value chain in the North mountainous areas of Laos

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[2] Project for Reinforcement and Expansion of Coffee Sector in Laos (RECoSeL)

Abstract

This article will assess the feasibility of sustainable coffee value chain in northern mountainous areas of Laos. Coffee is an important food commodity both for local consumption and export. This assessment will help future initiative activities to deal with facilitation and challenges of different actors in coffee value chain vis a vis organic and fair-trade standards and coffee production techniques. Mix-methodology was applied to evaluated different agents in coffee value chain. The results showed that coffee farmers have been motivated in increasing their coffee production and income according organic standards while fair-trade requirements are new for them. Applying Organic-Fair trade standards aimed to generate high quality of coffee for niche market and avoid massive production. However,

Keyword: small coffee farmers, organic and fair-trade, sustainable agriculture value chain

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Introduction

- Coffee is among the top Lao top agricultural export products which generated a total income
- Coffee sector supports livelihoods for over 100,000 people, among which about 25,000 are small farmers
- The production is concentrated mainly on the Bolaven Plateau in the South (95% of national production) with about 16 private companies growing coffee on land concessions, but concern on its ecological and economic sustainability.
- However, Lao coffee farmers and industries have still been faced many challenges, such as productivity, lack of minimum quality standards, high logistical costs, as well as low capacity for research and commercialization (Singhalath & Huong, 2021)
- RECoSeL project (North) aimed to increase quality and processing, commercial empowerment and farmer's organization through simple models, with attractive prices for green beans, short value-chains, domestic coffee companies/roasters and coffee farmers groups at village level. But this chain will saturate and North coffee production will be exportable in 2-3 years.
- In this assessment, the readiness of coffee farmers and process of organic and fair-trade certification will be examined.

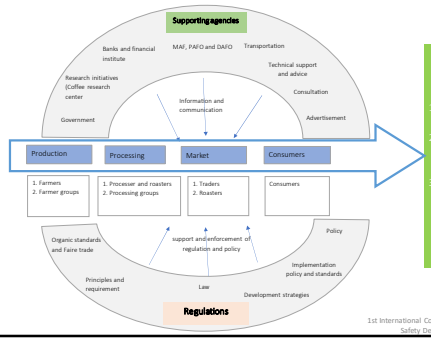
Objectives

- To assess the current organization of coffee farmers in typical contexts: new cultivated areas, areas with an existing production, and different operators.
- To make an evaluation of technical practices for coffee growing but also other neighboring farming or economic activities possibly impacting the eligibility to FTO certifications.
- To prepare some guidelines to drive RECoSeL sub-project operations towards the certification process: requirements, management of the process, financial solutions, and audits according regional and international organic or faire-trade standards.

Methodology

- We will use the conception structure and agency to formulate the view of research finding and pointing at what is needed to be focus for certifying organic or faire-trade standard
- For assessing the information, we will use social ecological model to capture and determine the targets of study
- With semi-quantitative and qualitative method (in-depth interview/IDIs, key informant interviews, and focus group discussion/FGDs) which are the actors from the donut model on coffee supply chain.

Donut model on coffee supply chain



Sustainable supply chain of coffee:

1. Coffee production can generate income and improve their livelihood
2. Enable protect agro-ecosystem, environment and biodiversity in production areas
3. Coffee producers and traders receive faire revenue and consumer satisfy quality and safety of coffee products

Results

Coffee producer characteristics

Table 1. Age of farmers

	Saysomboun	Louangprabang	Xiengkhuang	Houaphan	Phongsaly
Age of farmers (years old)	46.33±5.21	50.39±3.66	33.78±371	47.20±6.54	45.60±7.61

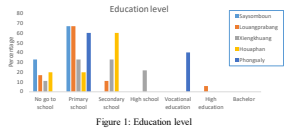


Figure 1: Education level

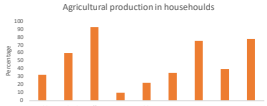
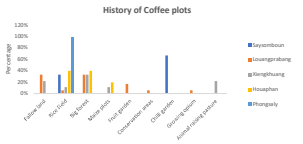
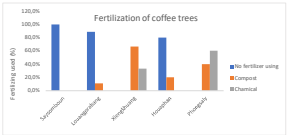
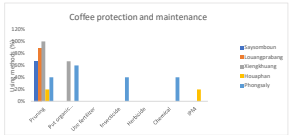


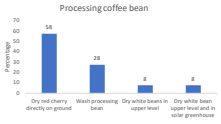
Figure 2: Agricultural production in households

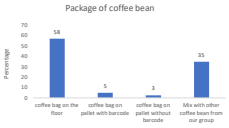


Farmer's Knowledge and practice of OFT coffee

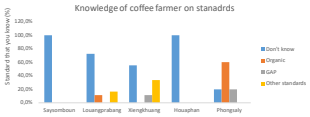


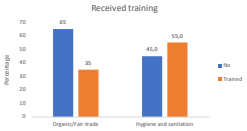




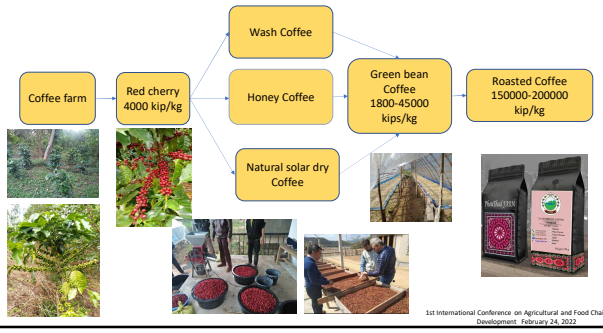


Perception on coffee standard and food safety





Coffee value chain in Laos



Opportunities and barriers on OFT coffee

SWOT Analysis for coffee producer groups

➢ Strength	➢ Weakness
➢ Coffee plots are in conservation areas that can prevent slash and burn agriculture and preserve forest ➢ Department of forestry allows farmers to grow quality coffee and protect forest ➢ Suitable climate and suitable soil ➢ Saffron is stable market, good buyer and high demand (Unlimited demand) ➢ Increase coffee consumers ➢ Producing coffee in forest generate minimal impact on environment and consumers	➢ Limited extension workers who can produce technical supports, advice and regular monitor ➢ Coffee production areas are on hill and isolated mountainous areas which are limited for expanding ➢ Coffee farmers lack production techniques and limited knowledge for coffee processing ➢ Farmers have not equipment and cannot added value to their coffee ➢ Lack of knowledge on different standards which can add value to their products ➢ Coffee disease is presented like yellow leaves branch disease, farmers did not know how to treat ➢ Some areas are not suitable due to poor soil and hard soil structure ➢ Low production
➢ Opportunity	**➢ Threats**
➢ Vanmai, MouangXieng, Saffron company needs to buy big quantity of quality coffee. ➢ RecoSel, PAFO and DAFO play important in coffee extension, providing training on coffee production techniques and maintenance of coffee trees ➢ PAFO staffs were learned about coffee standards ➢ Lao coffee currently is well known by local and international market ➢ Farmers started understanding coffee production techniques: seedling, transplant, maintenance, harvest, wash and dry ➢ Increase demand coffee from local and international market ➢ Increase support from companies and projects	➢ Not strict requirement on standards yet ➢ Difficult road for transportation of coffee ➢ Soil erosion ➢ Coffee price is still lower than other products ➢ Farmers are still worry on coffee plantation and unstable market demand. ➢ Coffee production is still low and cannot supply enough quantity for company because coffee trees are still small. ➢ Some families lack labor ➢ Farmers got bad experience from Chinese investor (not buy and disappear) and lost trust

SWOT Analysis for **traders/roasters** for OFT certification

➢Strength	➢Weakness
➢ Company locates near production areas and farmers that is easier for coffee purchase and sell. ➢ There is Thai coffee experts who training coffee sensory test, coffee cultivation and fertilization for company's staffs. ➢ There are systems which control production and purchase ➢ Company assures the market. If we cannot export, we have local markets ➢ Longer contact (Three years contract with farmers-MouangXieng) ➢ PAFO and DAFO were ready to provide agro-technical assistance with the supporting project like RecoSel and Saffron, etc	➢ Coffee production did not enough for market's demand ➢ (No contact with middleman) ➢ Selling roasted coffee beans is limited due to small roaster and can only sell in local market
➢Opportunity	➢Threats
➢ ➢ The quality of coffee is accepted by international buyer. ➢ There are different varieties of coffee which allow us to process to diverse products. ➢ Still able to expend local and international market ➢	➢ ➢ Pest and disease are destroyed coffee. ➢ High export tax. ➢ Controlling coffee quality is still challenging ➢ Farmers did not follow technical advices ➢ Farmer training cannot reach yet all targeted villages

SWOT of **extension worker's views** on coffee OTF certification

Strength	Weakness
- Farmers had existing coffee plots from former projects - Farmers have knowledge in coffee production - Cooperative supports full program for coffee farmers	- Lack of equipment for coffee processing. - Coffee is secondary agricultural activity, cow and NTFP products generated more income. - High chemical residue
Opportunity	**Threats**
- Eco-environmental conditions are suitable for coffee production - Three are big buyers: Uni coffee, Malongo and Vietnamese traders.	- Farmers have low experience for quality coffee production. - unsuitable processing facility. - difficult transportation. - Lack of coffee expert. - Lack knowledge on coffee standards (OFT) - Lack knowledge of intergraded cropping

Conclusion and recommendations

Agro-technical management

- Pest management and disease Control like Aphides, coffee plant disease will be needed
- Examining adequate nutrient supply and balance and soil analysis will define soil quality for coffee tree
- Increase coffee productivity, good harvest and processing will help farmers to increase their income.
- Integrated crops-coffee- animal raising could aim sustainable practices and secure soil nutrient and increase productivity
- Providing series of TOT training for extension workers and farmer training on coffee standards are needed such as GAP, OA, fair-trade and Organic-fair trade requirements.

Certification processes

- Increase awareness and practice standards both extension workers, farmers and traders should be prepared. Recording documents from different steps will be audited.
- Markets demand quality and safety standards, preparing farmers and farmer groups need to be patient. Coffee traders and cooperatives should take initiative for documentations and cover costs of certification.
- Certification of organic and faire-trade will be initiative from company, roaster and cooperative due to financial and education issues of farmers

Thanks for your attention



Evaluation of Pork Standard and Quality from CP Laos at Done Dou Slaughterhouse in Vientiane Capital

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The aims of this study were evaluation of pork standard and quality and pork processing from CP Laos Company in Done Dou slaughterhouse. The observation and questionnaires were used as the tools to collect the data during the pork processing, areas and surround of the slaughterhouse in CP Laos Company at Done Dou slaughterhouse. Results of this study, 1.65% of pig was obtained from CP Laos Company and 98.44% was obtained from farmer's farm. The age of pig was with a range of 5-6 months and the weight of pig was with a range of 90-120 g. All the pigs in the slaughterhouse were certified from district veterinarian. For the grades of pork, 44.49% was for the highest grade of B. 0.07% was for the smallest grade of F. The yield of pork was an average of 90.62% and the lost weight or waste pork was an average of 9.38%. The pork yields were divided to 2 productions such as freezing pork and fresh pork. 99.82% of pork yield was suggested to be freezing pork. The evaluation of pork standard and quality could show that the environmental management, water management, storage and transportation were identified to be a smallest risk or the risk was smaller than 10%. Personal hygiene, tools and materials were identified to be medium risk or the risk was with a range of 10-50%.

Key words: Slaughter house, Pork standard, Risk, Environment and Food Hygiene

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Introduction

- Pork is a kind of meat: high protein, fat, vitamin etc.
- The pork contaminates with pathogenic bacteria: *E.coli* and *Salmonella* (Phimphen, 2020)
- Low quality pork is due to the low food safety standard and quality control
- Consumers need a high quality of pork and diversity of grades
- A good Food safety standard can reduce the risk in pork

Introduction

- CP lao company. Ltd is located in Done Dou, Hakxayphong, Vientiane capital.
- CP lao company is the biggest suppliers of pork in Vientiane
- A GMP certificate is Needed, ISO14001

Objectives

- To check the pork processing
- To evaluate the safety quality of pork by using the GPM checklist

Methods

- All processing stages in the factory were checked by using the questionnaire and GMP checklist.
- All CP lao staffs were interviewed: Transportation Pre-slaughterhouse, Killing, Cleaning, cutting, Packing and selling

Risk level	Scores	Aliable
Low	1	<10%
Medium	2	30-50%
High	3	>50%

Data analysis

- Excel and Minitab 18

Minitab® 18

Results

- Pork processing

Pre-slaughterhouse
↓
Pork processing
↓
Post-slaughterhouse

1. Pre-slaughterhouse
   1. Farm (Pig)
   2. Transportation
   3. Receiving
   4. Breaking

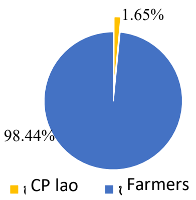
2. Pork processing

1. Killing (electricity)
2. Holding
3. Blooding
4. Blanching and cleaning
5. Head cutting
6. Inside cutting
7. Carcass cutting
8. Quality checking (LSQ)
9. Inspection
10. Wieghing

3. Post-slaughterhouse

1. Cutting and grading
2. packing
3. Weighing
4. Storage
5. Selling

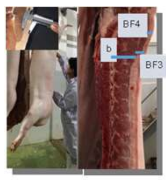
Source of pigs



Pigs were picked from 2 sources: CP lao company (1.65%) and Farmer (98.44%). The average of pig was 5-6 months, Weight was 90-120Kg/head.

ການປະເມີນເປີເຊັນຂອງຊີ້ນຈາກໝູແບບ LSQ

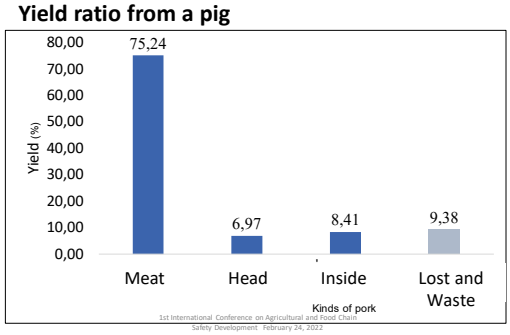
ຄ່າດັດສະນີ LSQ	ເກຼດ	ຊີ້ນແດງ (%)	ໄຂມັນ (%)	ສາມຊັ້ນ (%)	ດູກຂ້າງ (%)	ຂ້າໜ້າ+ ຂ້າຫຼັງ (%)
≤ 0.20	A	49.88	14.40	10.91	4.93	9.96
0.21-0.26	B	48.88	15.77	11.34	4.90	9.42
0.27-0.32	C	47.64	16.94	12.00	4.93	9.16
0.33-0.38	D	46.58	18.25	12.21	4.57	9.15
0.39-0.44	E	44.96	19.79	12.93	4.63	8.96
≥ 0.45	F	43.91	21.06	12.82	4.12	8.79



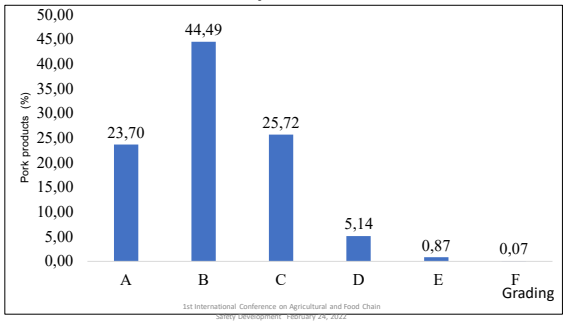
$$LSQ = \frac{BF3+BF4}{2B}$$

- BF3 : ແທກຈຸດທີ່ລຸ່ມຂອງຖານຮູບສາມຫຼ່ຽມຂອງກ້າມຊີ້ນ
- BF4 : ແທກຈຸດທີ່ມີມັນສັນຫຼັງບາງທີ່ສຸດ
- B : ແທກຈາກຈຸດມຸມລຸ່ມຂອງຖານຮູບສາມຫຼ່ຽມຂອງກ້າມຊີ້ນໄປຕັ້ງຈາກກັບທໍ່ໄຂສັນຫຼັງ

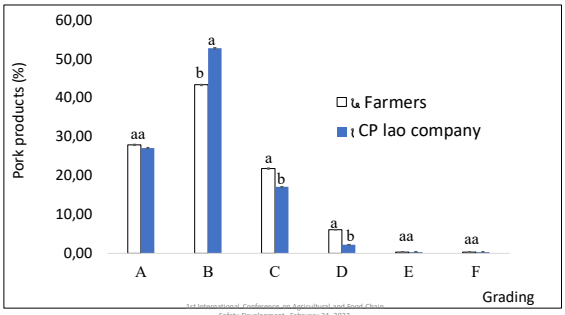
Yield ratio from a pig



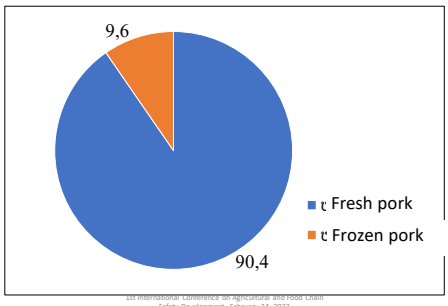
Pork productions



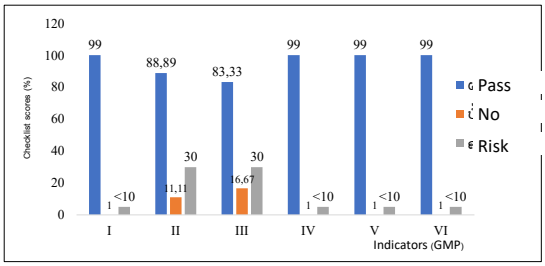
Pork production (cont.)



Kind of pork products



The evaluation of slaughterhouse



Note: I Environment and settlement, II Materials and tools, III Personal hygiene, IV Water management, V Pork hygiene VI Storage and transportation

Conclusion

- The most pigs was collected from farmers (98,44%). All pork were certificated from Company Veterinarian
- The pork grading were divided to 6 grades. The grade B was highest inducing 44.49% and the smallest was grade F including 1%. The total pork yield after killing, cutting and cleaning was 90.62%/head. The waste and lost of pork was 9.38%/head. The pork produces were divided to 2 types such as fresh pork was 90.40% and frozen pork was 9.60%
- The risk of environment and settlement, water management, pork hygiene and cleaning, storage and transportation was less than 10%. The risk of material, tool and personal hygiene was in a range of 10-50%

Recommendation

- The Materials/tools and Personal hygiene is a medium risk. So, It should be improved.
- A ISO14001 system is needed

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ENVIRONMENTAL IMPACT OF PESTICIDE USE FROM BANANA PLANTATION IN LAOS

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b Department of Crop Science, Faculty of Agriculture, NUOL
c Department of Soil Science and Environment, Faculty of Agriculture, KKU

1. Background and problem

Source: Asia News the Irrawady 16 May 2017

1. Background and problem (Continued)

Public interest in Laos regarding the environmental impacts

Sources: rfa radio free Asia 2017

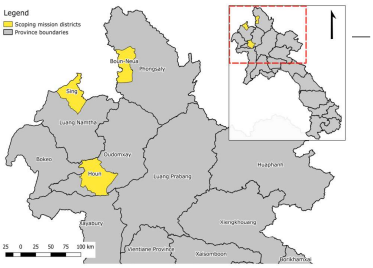
1. Background and problem

Source: Irrawaddy news, 16 May 2017

2. Objective

This research is devoted to report on pesticide risk exposal and the environmental impact of pesticide use from banana plantation in Laos

Banana plantation Area

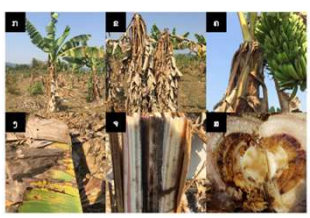


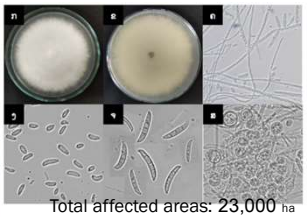
Banana Plantation in Laos

2020:
Laos exported Cavendish banana to China:
- ❑Total: 827,177 Ton
- ❑Total value: 168,023, 239 UD dollar.

❑Main markets: China, Thailand and Vietnam
(DOA, 2020)

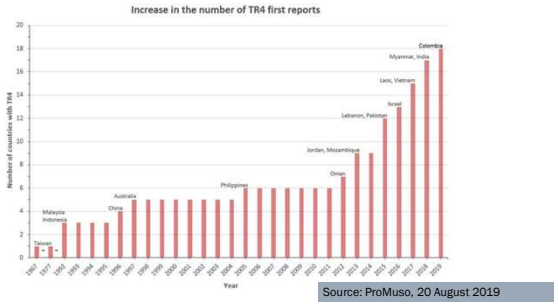
- ❑ **TR4 an important threat to banana production in Lao PDR**
  - *(Fusarium oxysporum* f. sp. *cubense* tropical race 4),



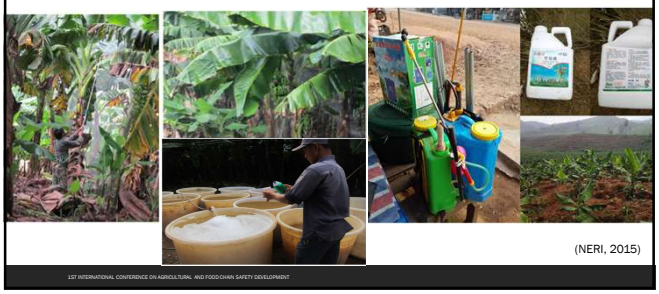


Total affected areas: 23,000 ha

DOA, 2017



3. Pesticide usage and Risk exposal



(NERI, 2015)

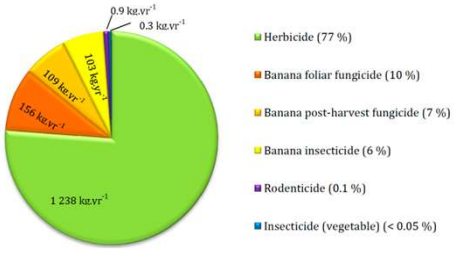
Banned pesticide of Lao PDR according to Rotterdam and Stockholm List

List of pesticide banned in Lao PDR

No	Chemical name	No	Chemical name	No	Chemical name
1	2,4,5 -T	20	Dimefox	38	Methomyl
2	Aldrin	21	Dinitrocresol	39	Methyl bromide
3	Arsenic compound	22	Dinoseb	40	Methyl parathion
4	BHC	23	Dinoterb acetate / Dinitrobutyphenol	41	Monocrotophos
5	Binapacryl	24	EDB	42	Oxamyl
6	Calcium arsenate	25	Endosulfan	43	Paraquat
7	Captafol	26	Endrin	44	Phorate
8	Chlordane	27	EPN	45	Phosphamidon
9	Chlordimeform	28	Ethyl Parathion	46	PMA
10	Chlorfenvinphos	29	Ethylene oxide	47	Polychlorocamphene
11	Chlorobenzilate	30	Fluoroacetamide	48	Schradan
12	Chlorthiophos	31	Heptachlor	49	Selenium compound
13	Cycloheximide	32	Hexachloro cyclohexane	50	Sodium Arsenite
14	Cyhexatine	33	Leptophos	51	Sodium chlorate
15	Daminozide	34	Lindane	52	Sodium fluoroacetate
16	DBCP	35	MEMC	53	TEPP
17	DDT	36	Mercury compounds	54	Thallium (i) sulfate
18	Demeton	37	Methamidophos	55	Toxaphene
19	Dieldrin				

Pesticide in Rotterdam Annex Pesticide in Stockholm Annex

1. Pesticide usage and risk exposal



2. Pesticide usage and risk exposal

Mixture of at least 7 pesticides used for plant spraying in a farm1

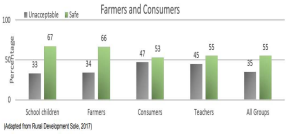
One of these products is an insecticide: imidaclopride

3. Pesticide usage and risk exposal

In 2016, the Provincial Health Departments and Rural Development Sole tested 449 students and teachers in Vientiane. 58% had unacceptable levels of exposure.

9

Chart 5: Blood Tests - Organophosphates and Carbamates in Xieng Khouang Province in 2017



(Adapted from Rural Development Sole, 2017)

4. Environment impacts of pesticide use in banana plantation

Surface Water Detections

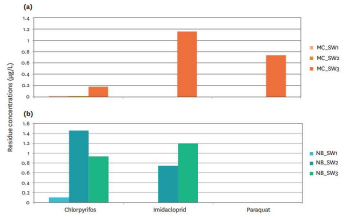
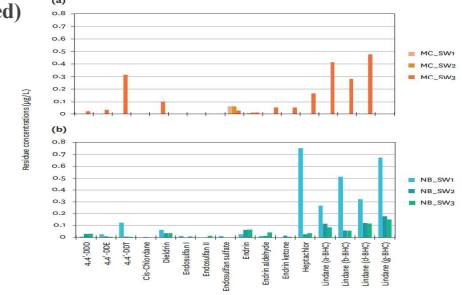


Figure 9. Maximum concentrations of CU pesticides in the wet season surface water samples in (a) MC, and (b) NB catchments. Compounds that were not detected were omitted from the chart.

Source: international water management institue, 2021

4. Environment impacts of pesticide use in banana plantation (continued)



4. Environment impacts of pesticide use in banana plantation (continued)

Groundwater Detections

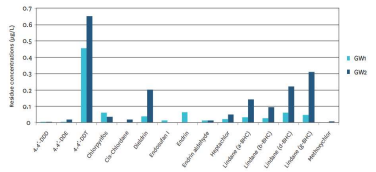
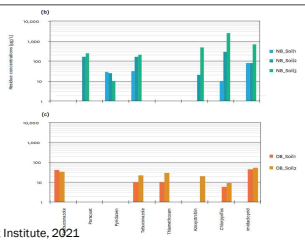


Figure 11. Maximum concentrations of OC compounds and chlorpyrifos in groundwater samples from both the wet and dry season sampling missions.

Source: International Water Management Institute, 2021

4. Environment impacts of pesticide use in banana plantation (continued)

Soil Detections



Source: International Water Management Institute, 2021

4. Environment impacts of pesticide use in banana plantation (continued)

Seasonal Variations in Frequency and Concentration of Pesticide Residue Detections

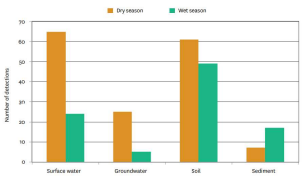


Figure 16. Frequency of detections for either OC or chlorpyrifos from the dry and wet season sampling missions.

Source: International Water Management Institute, 2021

5. Conclusion

1. Commercial banana farms in Laos rely heavily on agrochemical inputs to protect and enhance their crop.
2. There is on few study and scientific paper which review on Environmental Impact of Pesticide Use from Banana Plantation in Laos
3. Concentrations of two CU compounds— imidacloprid and paraquat—in the wet season surface water (stream) samples obtained from a banana farm exceeded the World Health Organization (WHO) environmental water quality guidelines.
4. Therefore, Environmental impact study of the major commercial banana growing areas is a necessary and important means of assessing the levels of risk and identifying appropriate mitigation measures.

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Impacted of COVID-19 on Aquaculture Production in Lao PDR

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National University of Laos

Background

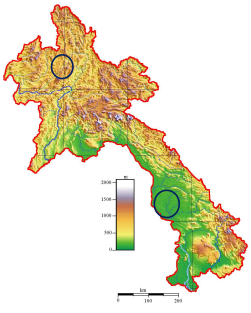
- Increasing high demand of aquaculture production in Laos during 5 – 10 years from recently.
- Challenging of Aquaculture production related to climate issues in the Mekong region.
- Coronavirus disease (COVID-19) outbreak situation in Laos and region

Objective: to understand on difficulty and barrier of farmers facing on their aquaculture production and as well as learn how farmer adapted to the issues related to COVID-19

Methods

Study areas: included 2 provinces

- Northern area: Oudomxay province (Xay district)
- Southern area: Savannakhet province (Kaisonephomviharn and Outhomphone districts)



Methods

Data collection:

- Individual interviews aquaculture farm: 49 farmers (25 farmers from Oudomxay and 24 farmers from Savannakhet).
- Used questionnaire form (Aquaculture farm activities, production, traiding, impacted of COVID-19,

Results and discussion

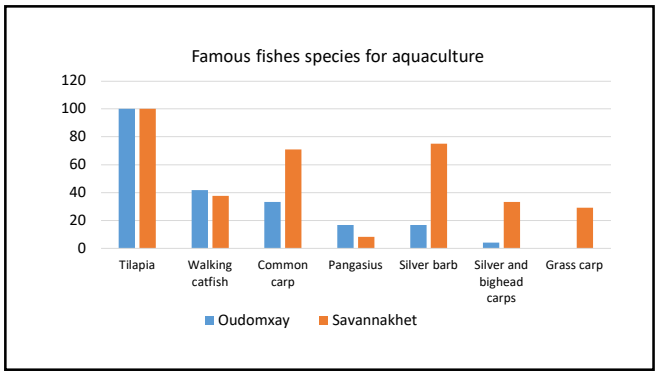
Status of aquaculture production

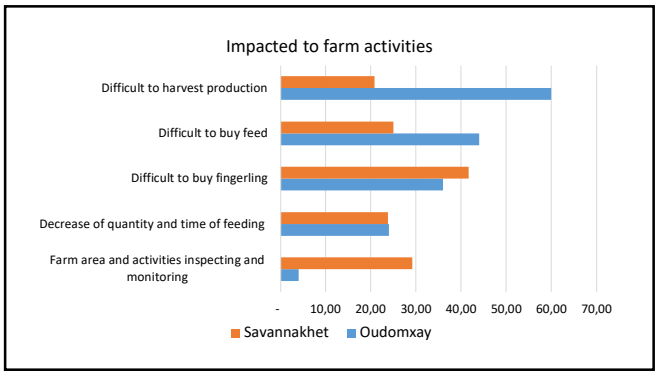
No;	Contents	Oudomxay	Savannakhet
1	% farmers interview	35.71%	27.91%
2	Gender involved of farm management		
	Male	68.00%	75.00%
	Female	32.00%	25.00%
3	Ages of aquaculture farm owner		
	Less than 30 years old	8.00%	12.50%
	Between 30 – 50 years old	60.00%	37.50%
	More than 50 years old	32.00%	50.00%

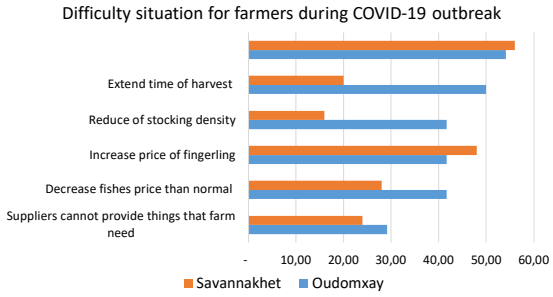
Results and discussion

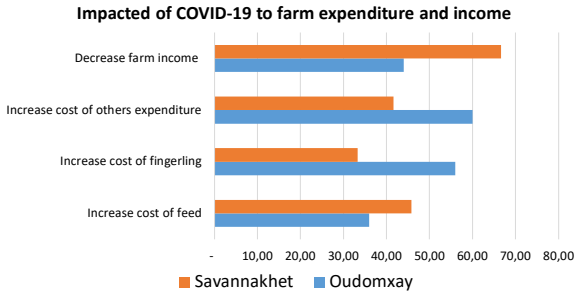
Status of aquaculture production

No;	Contents	Oudomxay	Savannakhet
4	Production systems:		
	- Earth pond	96.00%	66.66%
	- Plastic pond	2.00%	4.16%
	- Cage	2.00%	45.83%
5	Experiences of aquaculture production (More than 5 years)	84.00%	75.00%
6	Used commercial Feed	80.00%	80.00%
7	Land for aquaculture farm	Family ownership	Family ownership









Farmers adapted to COVID-19 impacted

No;	Contents	Impacted [%]	
		Oudomxay	Savannakhet
1	Easy to access to sources of finance	20.00	20.83
2	Reduce finance interest	20.00	25.00
3	Extent time of finances payment	32.00	16.66
4	Help to find sources of market access	44.00	25.00
5	Advise how to adapt to extreme situation	28.00	25.00
6	Support of finances in some issue	24.00	16.66

Discussion and conclusion

- COVID-19 outbreak during 2019 to 2021 high impacted to aquaculture production and farm business in 2 provinces of this research as well as in Lao PDR.
- This situation are similar with some countries in the Mekong region (Waiho et al. 2020); India (Kummaran et al. 2021); USA (Senten et al. 2020).
- Farmers adaptation (depend on farm scale)
  - Large scale is difficult to adapt
  - Midle and small scales are quick to adapt with the situation