ISBN 978-81-936279-9-0
10th Kuala Lumpur Int'l Conference on Environment, Agriculture, Biology & Natural Sciences (EABNS-18)
Kuala Lumpur (Malaysia) July 23-25, 2018

Analyzing Adoption and the Perceived Outcomes of Environment Friendly Good Agricultural Practices (GAPs) in Citrus Gardens: Orchardists' Point of View in Mazandaran Province, Iran

Ahmad Rezvanfar[1] and Fatmeh Razzaghi Borkhani[2]

[1] Professor, Faculty of Agricultural Economics and Development, University of Tehran, Iran
[2] Ph.D. Graduate, University of Tehran, Iran

***Abstract*:** *The main purpose of this study was to analyzing adoption and the perceived outcomes of environment friendly Good Agricultural Practices (GAPs) in citrus gardens in Mazandaran province, Iran. Study population consisted of all citrus orchardists in the selected villages of 12 counties in the Mazandaran province, Iran, which a sample of 290 orchardists were selected through proportional random sampling technique. A questionnaire was designed to collect the data, which it's both validity and reliability was determined by using expert opinion and Cronbach's alpha coefficient, respectively. The results of the study showed that priority adoption of the setting of Good Agricultural Practices (GAPs) Pests, Diseases and Weeds Management had first priority. Water management, Soil Management, Biodiversity, Energy Management, Nutrition and Fertilization, respectively, had allocated priorities from second to sixth. Also according to Orchardists' point of view about practical and perceived outcomes of adoption of GAPs, increasing access to global markets with orientation towards product export. Accordingly, in the next outcome, wide distribution of safe products with increasing competitiveness was the next important outcome as perceived by Orchardists. The third important outcome was about consumers' satisfaction and the fourth was increasing sales of products. Increasing information about use of environmental friendly methods and technologies as a basic behavior among farmers also was recognized as the fifth Perceived outcome.*

Keywords: *Good Agricultural Practices (GAPs); Adoption, Outcome; Citrus Gardens;*

1. Introduction

Around the world, concerns of health and safety in the food supply chain due to inappropriate application of technology and traditional agriculture systems, environmental demolition, economic problems and social inequalities increased (Rodriguez et al., 2009). In recent years, growing demand for sustainable agricultural development in response to the environmental impacts of conventional agriculture has added (Rasul & Thapa, 2004). Maintaining the product, regarding environmental considerations coupled with reduce production costs, producing a healthy crop and empowerment of farmers, is caused extension of widespread sustainable agriculture (Panahzadeh Parikhani et al., 2013). Pay attention to increasing appropriate environmental practices, increasing of crop export and consumer demand for safety and quality agricultural products, governments and private sector has increasingly encouraged in order establishing of Good Agricultural Practices (GAP) (Mankeb et al., 2014; Srisopaporn et al., 2015).

The concept of Good Agricultural Practices (GAP) is due to rapid changes of increase globalization in food supply, as well as the trust and confidence of stakeholders to safety control and quality assurance of food production, environmental sustainability of agricultural systems (FAOa, 2003; Pongvinyoo et al., 2014).

Good agricultural practices (GAP) described as understanding practices that followed to produce and eat safe crop, which is compatible with environmental sustainability. GAP principles have been applied at farm level for general ten components including soil management, water management, crop and fodder production, crop protection, animal production, animal health and welfare, harvest and on-farm processing and storage, energy and waste management, human welfare, health and safety, and wildlife and landscape conservation (Pongvinyoo et al., 2014; FAOb, 2003).

In total, good agricultural practices included as set of pro-environmental technologies. Those technologies consisting IPM, soil management, water management, crop and fodder production, crop protection, animal production, animal health and welfare, harvest and on-farm processing and storage, energy and waste management, human welfare, health and safety, wildlife and landscape conservation. The aim of those technologies are absorbent new market vantages by improving supply chain control, improving natural resource utilization, workers health, and working conditions, consumers and farmers families health and creating new market opportunities for farmers, also require obtaining new skills and competencies (Keshavarz et al., 2016).

According to Nirmala (2015) impacts of GAPs on small farms are enhance profitability and sustainability of farms. Ganpat et al. (2014) stated that GAPs adoption has potential to address consumers' needs for safety food and the requirements for export of produce and Educational - extension services and governmental intervention play an important role to adopt GAPs.

The study of Banzon et al. (2013) showed that GAPs adoption play important role to guaranty food safety and quality and enable farmers to gain new market opportunities by improving supply chain control, improving natural resource utilization, workers health, working conditions, consumers and farmers families' health.

Casandra (2011) in his study about that outcome of GAP adoption by farmers concluded that working among farmer groups and linking to other farmers support institutions and create food safety protocols and improve farmers' farm management and productivity. GAPs play an important role to strengthen competition in the market, promote export markets, develop export revenues, and help the rural economy.

The results of Mushobozi & Santacoloma (2010) in Tanzania indicated that GAPs not only have no harmful effect on consumer health but also improve market access, quality assurance, country economy and producers' livelihoods

According to the FAO annual statistics on the world production of citrus in 2013, China ranked as top producer with 22,940,000 tons and Iran ranked as 10th producer with 2,344,600 tons in the world (FAO, 2013). Iran has a comparative advantage in horticulture' crops production especially citrus products. About 23% of Iran' total horticulture production and 10.8% of fertile area dedicated to citrus products (Agricultural statistics of Agricultural Jihad Ministry, 2015).

Based on the amount of used chemical insecticides in 2015, Iran was located in 11th rank among all countries with consuming 5667.3 tons of active ingredient (FAOSTAT, 2015). Mazandaran province is one of the Northern provinces of Iran country, which located close to the Caspian Sea. Fertilizer consumption of Mazandaran province in 2015 was 64140, 18590 and 913 tons of N, P2O5 and K2O Fertilizers respectively, which means from total consumed fertilizers in Iran, 24.58 Percent of Nitrogen Fertilizers, 8.85 Percent of Phosphate Fertilizers and 5.50 Percent of Potash Fertilizers consumed in Mazandaran province (Heydarpour, 2014).

However, evidences show that in Iran, from 1991 to 2013, the production of citrus gardens has not increased while the chemicals use increased (figure 1). (FAOb. 2015). This means that using pesticides is not effectively to increase production amount. Thus, good management practices like GAPs technologies adoption is necessary to balance this Mazandaran province, as a case study is the top province to produce citrus products in Iran country as about 35% of country total citrus production produced in this province (Agricultural Jihad ministry statistics, 2015).

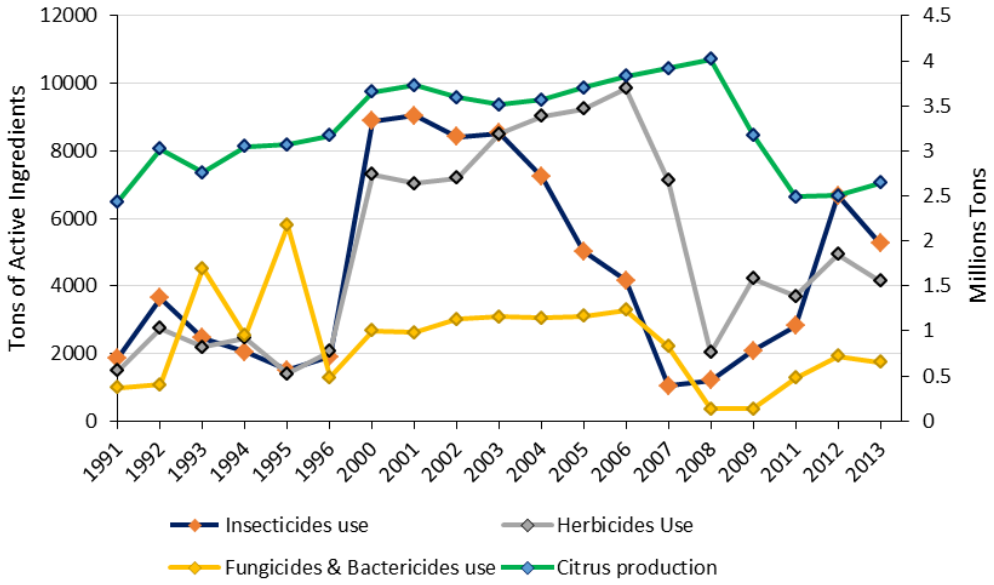

Fig 1. Iran' Pesticide consumption and Citrus Production during 1991-2013 (FAOb, 2015)

The main purpose of this study is exploring Perceived outcomes of Good Agricultural Practices (GAP) technologies adoption in Mazandaran province of Iran. The special objectives of the study are as follows:

- Identifying demographic characteristics of respondents;
- Priority setting of respondents' point of view about application Good Agricultural Practices (GAP) technologies
- Priority setting of respondents' point of view about Perceived outcomes of Good Agricultural Practices (GAP) technologies adoption;

2. Materials and Methods

This study is a descriptive-correlation research, carried out in Mazandaran province. The population of the study consisted of all citrus orchardists (N=122361) which belong to 12 counties of Mazandaran province.

A sample of 277 orchardists calculated by Cochran's formula but for more accuracy, the number of 290 orchardists selected through proportional random sampling method.

2.1. Study location

The study location is Mazandaran province in Iran country which is seen in figure 1.

Fig 2. The Geographical position of Mazandaran Province in Iran

2.2. Instrument

A research-designed questionnaire applied to collect data from the target group. The first part of this questionnaire asked farmers to specify their demographic and technical information such as age, educational

level, and gardening experience, Membership of local associations, Total income etc. The second part assessed level application Good Agricultural Practices (GAP) technologies among orchardists, the third part assessed orchardists' viewpoint about Perceived outcomes of Good Agricultural Practices (GAP) technologies adoption. Questions in a Likert-type scale ranged from 0 to 5 (0="none ", 1 ="very low", 2 = "low ", 3 = "intermediate ", 4 = "high" and 5 = "very high").

2.3. Validity and reliability of instrument

Validity of the instrument confirmed through experts' opinions of Mazandaran province and some faculty members at University of Tehran. Reliability of the instrument also confirmed by calculating Cronbach's Alpha coefficient, which was more than 0.70, and showed that the internal consistency of questions is good.

3. Results

3.1. Characteristics of the Orchardists

According to the findings, about 94.5% of Orchardists were men, and the average age of them was 49.5 years old. However, the majority of them (26.5 %) aged between 41 to 50 years. About 82% of the orchardists were literate and 18% were illiterate. The average respondents' experience in farming activities was 24.62 years and 60.7% had their own gardens .The average production of citrus was 32.3 ton annually.

3.2. Priority of adoption of Good Agricultural Practices (GAPs) among orchardist

The results shows that priority setting of adoption of environment friendly Good Agricultural Practices (GAPs) shows that pests and diseases and weeds management had the first priority because of having the lowest extent of coefficient of variation (CV = 0.228). Water management (CV= 0.261), Soil Management (CV= 0.270), Biodiversity, (CV= 0.283), energy (CV= 0.287) Nutrition and fertilization (CV= 0.839), respectively, had allocated priorities from second to sixth..

Table. I. Prioritization of Indicators Explaining the GAP among orchardists

priority	CV	S.D	mean	variable		
1	0.194	0.753	3.88	Pre-spring spray with volcanic oil with a definite concentration	Chemical	pests and diseases and weeds Management
2	0.273	0.890	3.74	Selection of toxins and authorized herbicides with the least harmful effect		
15	0.652	1.08	1.64	Use of IGR (Insect Growth Regulators) toxins		
1	**0.197**	**0.607**	**3.08**	**total**		
3	0.254	0.814	3.20	Mechanical Weed Control (Weeding, eradication, etc.)	Mechanical & physical	
4	0.279	0.957	3.43	Mechanical control of pests with tree pruning(remove additional branches)		
5	0.284	0.265	3.39	Destroy the polluted and suspected trees		
6	0.285	0.958	3.39	Mechanical control of diseases by removing dried branches, leaves and infected fruits		
7	0.288	0.935	3.24	Use safe and secure binding and linking resources		
8	0.296	0.997	3.36	Prevent of water collecting around the crown of the tree		
9	0.309	0.944	3.05	Use of pests and diseases resistant cultivars and varieties		
10	0.315	0.956	3.03	Differences in planting distance of citrus trees		
11	0.345	0.904	2.62	Select type and certified native seedlings		
12	0.379	1.05	2.77	Remove empty containers of toxins and collect them from the field		
14	0.481	1.01	2.18	Use of surface mulch		
16	0.683	1.10	1.58	Disinfection of gardening implements		
2	**0.229**	**0.671**	**2.93**	**total**		

13	0.420	1.03	2.45	Kaolin clay spit	Biological
17	0.738	0.982	1.33	Use of pest control trap such as yellow ribbons, Ceratrap , pheromones	
18	0.817	1.03	1.26	Mechanical control of weed and biological control of the cochlea with the release of poultry in the garden	
19	0.845	1.04	1.23	Biological control with parasites and parasites	
3	**0.476**	**0.734**	**1.57**	**total**	
1	**0.228**	**0.611**	**2.67**	**Total**	
1	0.242	0.684	2.82	Low water control and optimal water management in dry conditions Coping with thermal stresses	Water management
2	0.245	0.703	2.86	Irrigation scheduling (ordering irrigation periods and time intervals between courses)	
3	0.795	1.63	2.05	Use of drip irrigation system	
2	**0.261**	**0.675**	**2.58**	**Total**	
1	0.366	0.974	2.66	Use of varieties and varieties of citrus species	Biodiversity
2	0.381	0.976	2.56	Protecting migratory birds around or inside gardens	
3	0.434	0.948	2.18	Efforts to maintain the diversity of animal species, birds and natural predators (Use of poisons at the minimum hours of natural enemies activity)	
4	0.504	1.19	2.36	Operations related to the maintenance of soil microorganisms and earthworms	
5	0.504	1.11	2.20	Use of variety of genetic products in gardens in terms of livestock, crops and gardens (beekeeping in gardens or planting crops in gardens)	
4	**0.283**	**0.714**	**2.52**	**Total**	
1	0.339	0.899	2.65	Saving in terms of fuel consumption with minimum tillage and reducing machine traffic	energy
2	0.370	0.927	2.50	Engine fuel management for well pump and sprayers by minimizing spray and spray cycles	
3	0.401	0.995	2.48	Avoid water loss with drip irrigation system and irrigation scheduling	
4	0.512	1.06	2.07	Use of pruned residues and wood chips as biomass	
5	0.817	1.66	2.03	No use of drip irrigation system in peak hours of power consumption	
5	**0.287**	**0.675**	**2.35**	**Total**	
1	0.336	1.2	3.93	Use of chemical fertilize according to plant requirement	Nutrition and fertilization
2	0.342	1.01	2.94	The correct time is the consumption of fertilizer	
3	0.412	1.06	2.57	Mechanized fertilizer using standard cartridges and their calibration annually	
4	0.504	1.23	2.44	Use of compost animal and plant manure according to the plant's needs	
5	0.839	1.10	1.31	Use of biological and organic fertilizers (biological)	
6	**0.293**	**0.723**	**2.46**	**Total**	
1	0.316	0.836	2.64	Surface plowing 2 to 4 times per year (maximum plowing depth 10 cm)	Soil Management
2	0.410	0.924	2.25	Minimizing the plowing system and performing plowing practices by reducing the movement of agricultural implements	
3	0.415	0.993	2.39	Avoid Surface runoffs and Laying soil surface with proper drainage	
4	0.605	1.32	2.19	Integrated tree planting with planting plants such as algae and legumes, etc.	

5	0.772	1.28	1.76	Soil test in appropriate depth	
3	**0.270**	**0.830**	**2.24**		**Total**

3.3. Priority of Adoption and the Perceived outcomes of Good Agricultural Practices (GAP) from Orchardists' point of view

Table 1 shows that according to Orchardists' point of view about adoption and the perceived outcomes of Good Agricultural Practices (GAP), increasing access to global markets with orientation towards product export is the most important outcomes which orchardist percieved. In the next outcome, wide distribution of safe products with increasing competitiveness is the second important Perceived outcome. The third important outcome is about consumers' satisfaction and the fourth one is increasing sales of products. Increasing informed use of environment friendly methods and technologies as a basic behavior among farmers also recognised as the fifth Perceived outcome. These five outcomes are on top of other Perceived outcome, which shows their importance from orchardists' perspective (table 1). In addition, lead to use low-risk pesticides and environmental friendly pesticides and toxins and lead to minimum use of chemicals spraying by orchardists (once or twice in the year) had allocated last priority to itself.

Table I. Priority of adoption and the perceived outcomes of Good Agricultural Practices (GAP) from Orchardists' point of view

Statement	Mean	SD	C.V	Priority
Increase access to global markets with orientation towards product export	4.33	0.495	0.114	1
Play an important role to Widely distribute safe products with increasing competitiveness	4.24	0.563	0. 132	2
Increase the level of consumers' satisfaction	4.28	0.626	0.146	3
Increase sales of products	4.27	0.644	0.150	4
Increase informed use of environment friendly methods and technologies as a basic behavior among farmers	4.43	0.765	0.185	5
Play an important role in sharing and exchange of Information and knowledge from farmer to farmer	4.08	0.722	0.189	6
Ensure the health of consumer with prod using safe crops	4.17	0.796	0.190	7
Place the environmental health as head of important issues in agricultural practices	3.67	0.771	0.210	8
Increase earned training at the farm level through Participatory approaches such as farmer field school (FFS)	4.10	0.872	0.212	9
Encourage other farmers' to use GAP	3.76	0.840	0.223	10
Increase orchardists motivation to be the eminent	3.82	0.974	0.245	11
Play an important role in strengthening Local associations	3.56	9.909	0.255	12
Help orchardists paying attention to currency period of pesticides use from crop planting to harvesting	3.37	1.06	0.314	13
Place safety behavior on top of the health programs	4.12	0.957	0.349	14
Increase family members' tendency to use product	3.02	1.21	0.400	15
Lead to minimum use of chemicals spraying by orchardists (once or twice In the year)	2.53	1.18	0.466	16
Lead to use low-risk pesticides and environmental friendly pesticides and toxins	1.64	1.07	0.652	17

4. Discussion

The results of the study showed that GAPs technologies are essential to move toward sustainable agriculture. In other words, the GAPs outputs guaranty sustainability goals in agriculture. Perceived outputs of GAPs by citrus producers of Iran showed that adoption of GAPs had acceptable impacts among farmers and on society. Therefore, it is recommended to extend GAPs throughout the Iran by governmental and nongovernmental agricultural extension services.

Consumers' health and environmental friendly behaviors of the people are the main important output of adoption of GAPs amongst orchardists in Mazandaran province of Iran. It is related to ensuring the health of

consumers with producing safe crops. In addition, placing safety behavior on top of the health programs and using environment friendly methods and technologies in the production citrus shows that conservation and management of environment is another highlighted output of adoption of GAPs. The previous studies like Banzon et al.,(2013); Amekawa (2009) ; Carey(2008) ; Amekawa (2013) ; Shaw (2015); Achieng (2014) also confirmed this output and stated that environment friendly behaviors is an important output of adoption of GAPs.

Orchardists believed that their increasing awareness and getting knowledge about adoption and application of GAPs at the farm level, was happen through educational and extensional participatory approaches such as farmer field school (FFS) and played an important role in sharing and exchange of information and knowledge from farmer to farmer. As a results, information share among farmers encourage other farmers' to use GAPs and strengthen local associations by increasing farmers participation in local associations. In addition, more interaction to the institutions and social organizations by farmers will help them to get more knowledge and attitudes that are more favorable towards GAPs. According to James et al., farmer field school (FFS) training method has made valuable contribution to overcome sustainable agriculture problems especially environmental concerns through increasing awareness. However, for making training programs more effective, agricultural extension agents and research team members need to understand farmers' knowledge, attitudes, and practices (James et al., 2009).

It is recommended to empowerment of farmers and ensure their participation in decision-making process should be establish extension workshops by using delivery methods such as field demonstration and FFS.

It is highly recommended to highlighting the role of facilitators, advisors and extension agents for providing more appropriate educational and extensional messages about good agricultural practices (GAPs) and related farm management technologies. Since one of the barriers to adoption and application of sustainable GAPs, is farmers' low risk orientation, it is highly recommended to provide incentives such as loans and facilities for farmers to increase their application level of sustainable GAPs.

5. References

[1] Agricultural Statistics of Agricultural Jihad Ministry.2015. *Agricultural statistics in Year 2014, Horticultural products.* Ministry of Agriculture, Department of Planning and Economy, Center for Information and Communication Technology, 2015, First Edition, Volume 3, 156 pages. In Persian.

[2] Banzon, A.T., L.E. Mojica, A. Angela, and A.A. Cielo. 2013. Adoption of Good Agricultural Practices (GAP) in the Philippines: Challenges, issues, and policy imperatives. *Policy Brief Series-Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA).* No.1, pp.2, Los Banās, Philippines.[PubMed].

[3] Casandra, C. 2011. *An evaluation of The adoption of Good Agricultural Practices and food safety practices among small-scale cape gooseberry* (Physalis Peruviana) farmers in Boyaca, Colombia, Thesis Master of Science of Horticultural Biology ,Cornell University, 31August. [PubMed].

[4] FAO. 2013. *FAO Statically Yearbook 2013*. World Food and Agriculture, Food and Agriculture Organization of the United Nations, Rome.[PubMed].

[5] FAOa. 2003. Development of a Framework for Good Agricultural Practices. *Paper presented at the Committee on Agriculture*, Seventeenth Session, 31 March- 4 April 2003, Rome, Italy. [PubMed].

[6] FAOa. 2015. World fertilizer trends and outlook to 2018. *Food and Agriculture Organization of the United Nations*, pp.1-66, Rome. Available: http://www.fao.org/3/a-i4324e.pdf.

[7] FAOb. 2003. Development of a Good Agricultural Practices approach. Concept paper for the FAO Expert Consultation on Good Agricultural Practices. *Report of the Expert Consultation on a Good Agricultural Practices (GAP) Approach*, 10 - 12 November, Rome, ITALY. Available online: http://www.fao.org/prods/gap/Docs/PDF/1-reportExpertConsultationEXTERNAL.pdf. (Accessed on 23 October 2016).

[8] FAOb. *2015. Statically Yearbook*, World Food and Agriculture, Food and Agriculture Organization of the United Nations, Rome.[PubMed] .

[9] FAOSTAT. 2015. The Resources input domain contains annual data on: Fertilizers, pesticides. The agricultural production domain covers, *FAO statistics division*, Available online: http://faostat.fao.org/site/339/default.aspx.

[10] Ganpat, W., N. Badrie., S. Walter., L. Roberts., J. Nandlal., N. Smith. 2014. Compliance with Good Agricultural Practices (GAPs) by state-registered and non-registered vegetable farmers in Trinidad, West Indies. *Food Security*, 6(1):61–69. [PubMed].

https://doi.org/10.1007/s12571-013-0322-4

[11] Heydarpour, D. 2014. First place in Mazandaran produced 14 garden crops and livestock. *Monthly Livestock and agro-industry*, 177, January 2014. In Persian.

[12] Hobbs, J. E. 2003. Incentives for the adoption of Good Agriculture Practices (GAPs). Background paper for the FAO consultation on Good Agricultural Practices, Rome, 10-12 November, 2003. Available: http://www.fao.org/prods/gap/DOCS/PDF/3IncentiveAdoptionGoodAgrEXTERNAL.pdf.(accessed on 23 October 2016).

[13] James A, Litsinger., Edgar M, Libetario., and Bernard L, Canapi. 2009. Integrated Pest Management: Dissemination and Impact, Eliciting Farmer Knowledge, Attitudes, and Practices in the Development of Integrated Pest Management Programs for Rice in Asia, Springer Netherlands, 2: 119-273.[PubMed].

[14] Keshavarz, M., F. Razzaghi Borkhani ., M. Salmani., and A. Rezvanfar. 2016. Educational and Psychological Factors Influencing Application of Pro-Environmental Technologies among Wheat Growers. *International Journal of Research in Agricultural Sciences (IJRAS)*, 3(3):152-158 .[PubMed].

[15] Mankeb ,P., T. Limunggura., I.G. Anuson., P. Chulilung. 2014. Adoption of Good Agricultural Practices by Durian farmers in Koh Samui district, Surat Thani Province, Thailand. Conference: Society for Social Management Systems (SSMS), 6pp, Sydney, Australia on 2nd-4th, December 2013. *Publisher in Society for Social Management Systems Internet Journal*, Kochi University of Technology Academic Resource Repository, JAPAN. [PubMed].

[16] Mushobozi, WL., P. Santacoloma. 2010. *Good Agricultural Practices (GAP) on horticultural production for extension staff in Tanzania, training manual*. Food and Agriculture Organization of the United Nations (FAO), Rome. Available: http://www.fao.org/docrep/013/i1645e/i1645e00.pdf.

[17] Nirmala, G. 2015. Impact of Good Agricultural Practices (GAP) on small farm development: knowledge and adoption levels of farm women of rain fed areas. *Indian Res. J. Ext. Edu*,15 (4):153-156. Special Issue. [PubMed].

[18] Panahzadeh Parikhani , M., F. Razzaghi Borkhani., H. Shabanali Fami., N.Motiee., A. Hosseinpoor. Major barriers to application of Good Agricultural Practices (GAPs) technologies in sustainability of livestock units. *Int. J. Agric. Manage. Dev*. 5(3):169-178. [PubMed].

[19] Pongvinyoo ,P., M. Yamao., and K. Kenji Hosono. 2014. Factors affecting the implementation of Good Agricultural Practices (GAP) among coffee farmers in Chumphon Province, Thailand. *American Journal of Rural Development*, 2(2): 34-39. [PubMed].

https://doi.org/10.12691/ajrd-2-2-3

[20] Rasul, G., G.B. Thapa. 2004. Sustainability of ecological and conventional agricultural systems in Bangladesh. An assessment based on environmental, economic and social perspectives. *Agricultural Systems*, 79: 327–351. [CrossRef] [PubMed].

https://doi.org/10.1016/S0308-521X(03)00090-8

[21] Rodriguez, J. M., J. J. Molnar., R. A. Fazio., E. Sydnor., and M. J. Lowe. 2009. Barriers to adoption of sustainable agriculture practices: Change agent perspectives. *Renewable Agriculture and Food Syste*ms, 24 (1): 60-71. [CrossRef] [PubMed].

Srisopaporn, S., D. Jourdain., S.R. Perret., and G. Shivakoti. 2015. Adoption and continued participation in a public Good Agricultural Practices program: The case of rice farmers in the Central Plains of Thailand. *Technological Forecasting and Social Change*, 96, 242–253. [CrossRef] [PubMed].