Communication Model in Integrated Cropping Calendar Information System Implementation at the Farmer Level in West Java

Abdul Aziz[1], Pudji Muljono[2], Irsal Las[3], Retno Sri Hartati Mulyandari[4], Yayan Apriyana[5], Aris Pramudya[6]

{ayizhar@yahoo.com[1], pudjimuljono@gmail.com[2], irsallas@indo.net.id[3], retnoshm@yahoo.com[4], yanapri@yahoo.com[5], arispramudia@yahoo.com[6]}

Indonesian Center for Agricultural Technology Assessment and Development, Jl. Tentara Pelajar No. 10 Bogor 16114 West Java[1], Faculty of Human Ecology, IPB University, Jl. Kamper Kampus IPB Darmaga, Bogor, Indonesia[2], Indonesian Center for Agricultural Land Resources Research and Development, Cimanggu, Bogor, Indonesia[3], Secretary, Directorate General of Horticulture, Jl. AUP No. 3 Pasar Minggu Jakarta Selatan, Indonesia[4], Indonesian Agroclimate and Hydrology Research Institute[5,6]

Abstract. The study aimed to identify the communication model and the variables that influence the implementation of the planting calendar at the farmer level in West Java. The Partial Least Squares Structural Equation Modeling (PLS-SEM) method used in this analysis with exogenous (which influenced) variables in the form of government support, environmental support; agricultural extension support; Cropping Calendar Task Force support; farmer characteristics; social system; communication media; and the features of the planting calendar technology, while the level of implementation of the planting calendar by farmers and the level of sustainability of the performance of the planting calendar are endogenous variables (which are affected). The results showed that the adoption rate of farmers' planting calendars was positively influenced by exogenous variables meanwhile the variable degree of application of the planting calendar by farmers has a positive effect on endogenous variables with feedback from the farmers to Integrated Cropping Calendar Information System.

Keywords: communication model, cropping calendar, information system

1 Introduction

Climate change contributes to a slew of issues that affect virtually every country. This natural occurrence has happened on a global, regional, and local scale and is characterized by melting ice at the poles, resulting in increasing sea levels and floods. Additionally, this increasingly unpredictable and severe weather condition results in a long dry season rise in air temperature, changes in seasons and rainfall patterns, and affects an area's water availability [1]; [2]. This state is indicative of climate change.

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Floods and protracted droughts are two of the effects of climate change on agriculture, affecting cropping patterns, planting area, and harvesting, resulting in decreased production and even crop failure [3]; [4]; [5]. West Java is one of Indonesia's provinces and the centre of the country's rice production. Climate change has impacted cropping patterns in West Java, resulting in reduced rice production and crop failure. In 2019 rice production in West Java decreased by 5.83% from the previous year [6].

One of the local government's attempts to overcome climate change circumstances is to use The Integrated Cropping Calendar Information System (ICCIS) as an adaptation to climate change. ICCIS is a new innovation produced by the Indonesian Agency for Agricultural Research and Development (IAARD), Ministry of Agriculture in the form of an application that utilizes information technology to provide information on planting time, fertilizer requirements, and varieties suitable for development in a particular area. The preparation and development of the ICCIS application is based on the substance, model, as well as in the communication system and its distribution [7]. ICCIS is a tool for users in determining planting time, standing crops information, varieties recommendation, using balanced fertilizers, controlling drought, flood, plant pest, and diseases, using agricultural tools and machines. ICCIS has an important role as an agricultural information technology to support accelerated adoption of climate change-based and location-specific technologies. Therefore, the ICCIS application can be accepted as an innovation that can have a positive impact on users [8].

The comprehensive ICCIS is ineffective unless it is distributed to stakeholders and end-users. The ICCIS has been disseminated to users, particularly agricultural extension workers (PPL) and farmers [7]. Dissemination of ICCIS information to extension workers and farmers has been carried out as much as possible. However, the problem that occurs in the field is that PPL has not disseminated ICCIS to all farmers in West Java. [9] stated that the application of agricultural extension is not always successful because the message conveyed to farmers is still far from the goal. [10] stated that extension services were less effective because communication was not routinely communicated to farmers. Besides that, farmers are still accustomed to using hereditary habits in farming. This is in accordance with the opinion of [11] that there are still many farmers in Nigeria who use traditional methods in conducting agricultural business systems. In the 2016 Annual Report of the Indonesian Center for Agricultural Technology Assessment and Development (ICATAD), it was stated that based on the information obtained, agricultural extension activities related to the transfer of ICCIS information were only limited to outreach activities and only a small part conveyed the results of the socialization to farmers [12].

Based on these problems, the purpose of this study is to determine the factors that influence farmers in implementing ICCIS and to develop a communication model in implementing ICCIS at the farmer level.

2 Methodology

This research was conducted in 2019 in the West Java region. The location of the research was carried out in 2 districts, namely Indramayu and Subang districts. The survey in Indramayu regency was carried out in 2 sub-districts, namely Karangampel and Kandanghaur. Then in Subang regency, it was carried out in Ciasem sub-district. Based on the 2019 West Java Statistics, the three locations are among the highest rice producers in 2019 and 2018 [6].

This study was designed using a quantitative approach and strengthened by qualitative data analysis. A quantitative approach was used to test the research hypothesis. Meanwhile, the qualitative approach is to obtain a description of what is happening in the field and to deepen the study of research results. Research hypothesis testing is done by collecting data through surveys to respondents to obtain the variables that influence farmers in implementing ICCIS and formulating an appropriate model to improve ICCIS implementation.

Qualitative data collection was carried out using an in-depth interview approach, direct observation in the field, and Focus Group Discussion (FGD). This activity was carried out to obtain data on government support, environmental support, agricultural extension support, research support/ICCIS Task Force Team, ICCIS characteristics, communication channels, social systems, and the level of implementation of ICCIS by farmers, as well as added value in the use of ICCIS.

In this study, respondents who will be the object of research are farmers who are members of farmer groups and are engaged in the food crops sub-sector and have received ICCIS socialization at the research location. Sampling in this study was carried out by purposive sampling method. This sampling technique is carried out by determining specific criteria, namely farmer groups that have received ICCIS socialization. The determination of this sampling technique is based on the unavailability of recorded data for farmers who have implemented ICCIS. The number of samples in this study were 23 farmers who had received ICCIS socialization.

The data analysis technique used in determining the factors that influence the implementation of ICCIS at the farm level is by using Structural Equation Modeling-Partial Least Square (SEM-PLS). Then the results of the SEM-PLS analysis are also used as a basis for designing a communication model in the implementation of ICCIS at the farmer level. Before performing data analysis with SEM-PLS, the data was first inputted, cleaned, coded, and tabulated using Microsoft Excel Office 365.

3 Result and Discussion

The resultant model must satisfy the requirements established by the SEM-PLS analysis through the evaluation step, which involves performing the goodness of fit (GOF) analysis. In this study, GOF evaluation was carried out by measuring the validity and reliability of the model. The measurement of the validity of the model is carried out through convergent and discriminant tests, while the measurement of the reliability model is carried out by means of a reliability test.

The results of the convergence test in this study were carried out by looking at the Average Extracted (AVE), communality, and outer loading values. A model is said to have a valid latent variable if the AVE and communality values are greater than 0.5 and the outer loading value is greater than 0.7 [13]. Convergent validity results can be seen in Table 1.

Table 1 shows that most of the latent variables have AVE and communality values greater than 0.5 and outer loadings values greater than 0.7. So that the latent variable can be concluded as convergently valid. The latent variables are Environmental Support (ES), Government Support (GS), ICCIS Task Force Team Support (TFS), Agricultural Extension Support (AES), Farmer Characteristics (FC), ICCIS Technology Characteristics (ITC), Value Added Utilization of ICCIS (VAI), Communication Channel (CC), Social System (SS), Level of Farmers' Implementation of ICCIS (FII).

Table 1. Convergent validity value

Laten Variables	AVE	Communality	Outer loading	Description
ES	1.000.000	1.000.000	1.000.000	Valid
GS	1.000.000	1.000.000	1.000.000	Valid
TFS	0,839433	0.839433	0,916179	Valid
AES	1.000.000	1.000.000	1.000.000	Valid
FC	1.000.000	1.000.000	1.000.000	Valid
ITC	0,914173	0.914173	0,956092	Valid
VAI	1.000.000	1.000.000	1.000.000	Valid
CC	0,777354	0.777354	0,880246	Valid
SS	1.000.000	1.000.000	1.000.000	Valid
FII	0,538653	0.538653	0,726039	Valid

The results of the discriminant test were carried out by looking at the root value of the AVE and the cross loading value. The AVE root value in this study is greater than the correlation between latent variables. Then the cross loading value generated in this study is greater than 0.7 in one variable. Thus the indicators used to measure each variable have been discriminantly valid.

Measurement of reliability test can be done with Cronbach's alpha and composite reliability. However, composite reliability (CR) is considered better in estimating the internal consistency of a construct [14]. The results of the reliability test measurements in this study can be seen in Table 2.

Table 2. The realiability test measurements

Laten Variabels	Cronbachs Alpha	Composite Reliability
ES	1,000,000	1,000,000
GS	1,000,000	1,000,000
TFS	0.809011	0.912704
AES	1,000,000	1,000,000
FC	1,000,000	1,000,000
ITC	0.906832	0.955159
VAI	1,000,000	1,000,000
CC	0.724460	0.874375
SS	1,000,000	1,000,000
FII	0.150528	0.695604

Table 2 shows that the Cronbachs Alpha value for the latent variable is greater than 0.6 except for the FII variable. Then the Composite Reliability value on the latent variable is greater than 0.7. Although there is 1 variable (FII) that has a Composite Reliability value of less than 0.7, but because its value is very close to 0.7, it can still be used. So it can be concluded that all the variables used in this study are reliable.

The results of hypothesis testing from the SEM-PLS analysis show that there are several exogenous variables that affect the implementation of ICCIS at the farm level. These variables have a variable coefficient value > 1.64, so that these variables are said to be able to influence the implementation of ICCIS at the farm level. The results of testing the hypothesis can be seen in Figure 1.

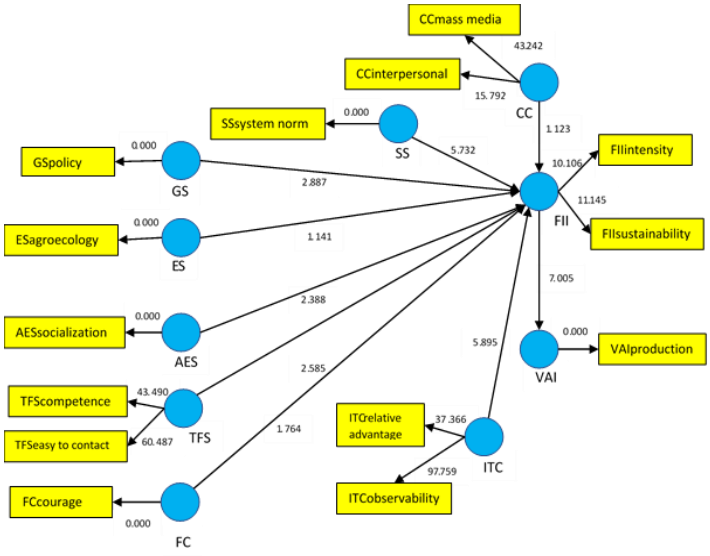

Fig. 1. Hypothesis test results on variables through SEM-PLS analysis

The results of the SEM-PLS analysis in Figure 1 show that there are variables that have a statistical test value greater than 1.96 on the implementation of ICCIS at the farm level. The variables are GS variable with a value of 2.887, AES with a value of 2.388, TFS variable with a value of 2.585, ITC variable with a value of 5.895, and SS with a value of 5.732. Then the FII variable has a statistical test value of 7.005 against VAI. The results of the analysis interpreted that there was a significant effect of government support, agricultural extension support, ICCIS task force team support, ICCIS characteristics, and social systems on the implementation of ICCIS by farmers in West Java. Furthermore, the implementation of ICCIS by farmers has a significant effect on the added value of the use of ICCIS.

3.1 Factors that influence the implementation of ICCIS and the added value of using ICCIS

The implementation of ICCIS at the farm level is influenced by several factors. The results of the SEM-PLS analysis show that there are several factors that influence the implementation of ICCIS and the added value of using ICCIS. The factors that influence the implementation of ICCIS at the farmer level are government support, agricultural extension support, support from the ICCIS task force team including researchers involved in the development of ICCIS. Another influencing factor is the characteristics of ICCIS and the social system. In addition, the factor that affects the added value in the use of ICCIS is the implementation of ICCIS at the farmer level.

Government assistance is one element that may affect farmers' adoption of ICCIS. The regional government of West Java aims to improve rice production to attain food self-sufficiency and farmer welfare. Local governments usually offer information on utilising ICCIS to determine planting dates and other technological recommendations through letters addressed to

agricultural extension workers and farmers. In addition, local governments also always encourage agricultural extension workers to continuously assist farmers in increasing rice production and farmers' welfare. [15] stated that most farmers consider government support to be very important in the agricultural system and the success of farmers because in addition to regulations, farmers also hope to get assistance with infrastructure and production facilities. The local governments of Indramayu and Subang have facilitated farmers in building irrigation canals to irrigate rice fields, however, this has not been accompanied by maintenance of the infrastructure.

Agricultural extension workers are the key to success for farmers in running their farms so that they have high competitiveness. The success of farmers can be realized if they get support from agricultural extension workers. Agricultural instructors are required to master technology so that they can transfer technological innovations to farmers quickly, easily, and cheaply. The support provided by agricultural extension workers in the implementation of ICCIS is to provide socialization and assistance to ICCIS to farmer groups and farmers. Farmers' perceptions of ICCIS socialization and assistance activities are presented in Table 3.

Table 3. Agricultural extension support in the implementation of ICCIS at the farmer level.

Agriculture Extension Support	Percentage (%)			
	Never	Sometimes	Always	No answer
ICCIS socialization	8.70	8.70	52.17	30.43
ICCIS assistance	8.70	8.70	69.57	13.04

Reliable extension workers must be able to carry out their role in the extension sector such as technology transfer, facilitation, and consulting [16]. Extension workers have an important role in transferring technology from both a technical and social perspective to farmers. One of the tangible manifestations of agricultural extensions in technology transfer is by conducting socialization related to ICCIS to farmers. Table 1 illustrates that most of the respondents (52.17%) stated that agricultural extension workers always provide ICCIS socialization to farmers. Through socialization, farmers can find out information on when to start planting and other technology recommendations. ICCIS socialization is carried out in a structured or unstructured manner. Structural socialization is carried out by planning ICCIS socialization activities to the heads or administrators of farmer groups at a predetermined place and time. This activity will run if it is supported by policies from the local government and an adequate budget. The unstructured socialization process is carried out by agricultural extension workers when carrying out routine extension tasks to farmers in places that are not previously determined (non-formal).

Other extension support is related to mentoring. Mentoring as a form of agricultural extension business in facilitation and consultation activities. Mentoring is an agricultural extension activity in meeting the information needs needed by farmers so that they can improve farmers' knowledge and skills [16]. Table 1 shows that 69.57% of respondents stated that agricultural extension workers always provide assistance to farmers in the implementation of ICCIS. Assistance is intended to provide extensive advice from agricultural extension workers to alter farmers' attitudes about ICCIS implementation. Farmers communicate their concerns to agricultural extension workers to be regarded as colleagues capable of resolving issues in the field. Agricultural instructors are required to listen to farmers' concerns and issues and assist farmers in developing alternate solutions to their problems. Farmer groups and farmers always

invite agricultural extension workers to attend meetings which are held every month or every three months. At the meeting, agricultural extension workers were asked to provide information related to the planting schedule, determining the varieties to be planted, ideal fertilization, estimates of pests and diseases that will attack plants, as well as agricultural tools and machines to be used.

The support of the ICCIS Task Force Team (TGT Katam) is one of the variables that has a significant influence on the implementation of ICCIS at the farmer level. Some members of the TGT Katam are researchers who are given the task and responsibility to support and be actively involved in the ICCIS preparation process and ICCIS implementation activities in their area. TGT Katam indicators that affect the implementation of ICCIS at the farmer level are the competence of TGT Katam and ease of contact. One of the supports from TGT Katam is to convey ICCIS information to PPLs and farmers so that they must master the material related to ICCIS comprehensively. In addition, TGT Katam must also be easily contacted by agricultural extension workers and farmers so that they can submit complaints and problems in the field. Competence and ease of contacting TGT Katam are presented in Table 4.

Table 4. Competence and ease of contact from TGT Katam

Task Force Tim Support	Percentage (%)			
	incompetent/hard to contact	competent enough/easy enough to contact	Competence/easy to contact	No answer
Competence	4.17	12.50	54.17	29.17
Easy to contact	17.39	8.70	52.17	21.74

Table 4 describes the majority of respondents (54.17%) stating that TGT Katam is competent in conveying ICCIS information to agricultural extension workers and farmers. The results of interviews with respondents stated that TGT Katam is an educated and expert employee in the field of agriculture so that they can master the material and are able to convey ICCIS information well. Then 52.17% of respondents perceive TGT Katam as easy to contact so that TGT Katam communication with agricultural extension workers and farmers in utilizing ICCIS can be carried out properly. Based on interviews, respondents stated that TGT Katam is easy to contact because if they are asked for advice and opinions, TGT Katam will provide what information agricultural extension workers and farmers need.

The characteristics of ICCIS are one of the factors that influence the implementation of ICCIS at the farmer level. Based on the factor analysis using the SEM-PLS method, two indicators that best reflect the characteristics of the ICCIS technology are obtained, namely the level of relative advantage and observability. Relative advantage is the level of excess of an innovation, whether it is better than previous innovations or from things that are usually done [17]. Someone will take advantage of an innovation if it is profitable for that person. ICCIS technology will be utilized by farmers if farmers feel benefited [7]. ICCIS profitability and observability are presented in Table 5.

The survey results in Table 5 show that 47.83% of respondents stated that there were relative benefits from implementing ICCIS. Through ICCIS, agricultural extension workers and farmers can determine the start of planting time, cropping patterns, potential planting area, and the right technology in farming. ICCIS can also provide information on the types of varieties that are

recommended to be planted in a location. Related to fertilization, farmers can find out the amount of fertilizer that must be used for farming in a balanced way. Through ICCIS, farmers can also find out the types of pests and diseases that will attack plants. Thus, farmers can anticipate pesticides that must be prepared to control pests and diseases that will attack plants.

Table 5. ICCIS characteristic indicators that affect ICCIS implementation

ICCIS characteristic indicators	Percentage (%)			
	not profitable/ not observable	quite profitable/ quite observable	Profitable/ Observable	No answer
Relative advantage	4.35	47.83	47.83	0.00
Observability	4.35	26.09	69.57	0.00

Based on the survey results in Table 5, this study illustrates that most of the 69.57% respondents stated that ICCIS is observable. Thus, the level of ICCIS observability can be categorized as very easy to see and observe by others. This is because many farmers have seen the results of implementing ICCIS recommendations through demonstration plots (demplot). Demplot or trials are carried out on farmers' land to prove whether the recommendations suggested by ICCIS are successful or not. [18] defines observability as the level of ease of an innovation to see the results and the ability of observations made by users of the implementation of an innovation, as well as the ease with which the results of the innovation are communicated to others. The results of the SEM analysis show that observability is an indicator that can affect the implementation of ICCIS. Farmers became interested in ICCIS after seeing the success of the demonstration plot process on the land of one of the farmers. The good demonstration plot results are an attraction for other farmers to apply ICCIS.

Based on the results of the SEM-PLS analysis, the social system is one of the variables that affect the implementation of ICCIS at the farmer level. The social system is a system consisting of elements that are interconnected so as to form a social value or norm that is carried out in everyday life [19]. In this study, a significant indicator of the social system variable is norm system. The System norms in the implementation of ICCIS are community rules or habits that interact with each other in increasing agricultural production and community welfare.

Most of the people in this research location are farmers, so they need technological information which is expected to increase agricultural production and farmers' welfare. However, the introduction of technology offered must be in accordance with local social and cultural conditions. The survey results show that 47.83% of respondents stated that ICCIS technology is sometimes in accordance with local socio-cultural conditions. The initial determination of planting time by farmers in the Subang area is by looking at the condition of the leaf buds of the tamarind tree. If the leaf shoots have started to grow, it is a sign that the rainy season has started and farmers can start planting. Before 2018, ICCIS technology was in accordance with conditions in the region, but after 2018 there were several ICCIS recommendations that were not in accordance with conditions in the field. This is due to the lack of government budget for the ICCIS program so that socialization activities are decreasing or almost non-existent. Thus, farmers assume that the ICCIS program is no longer running.

3.2 Communication model development in ICCIS implementation

The implementation of ICCIS by some farmers is carried out through a communication process. Communication is carried out in stages from TGT Katam, local government, agricultural extension workers, to end users, namely farmers. Based on the results of the SEM-PLS analysis, the communication process and model can be seen in Figure 2.

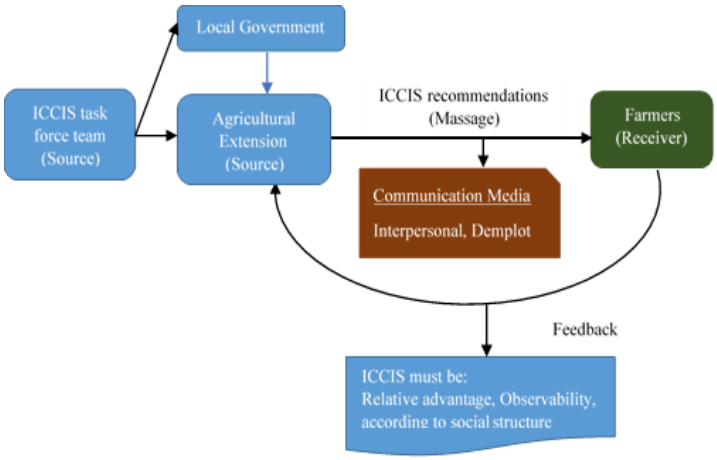

Fig. 2. The process and communication model for ICCIS implementation at the farmer level in the West Java region

Figure 2 shows that the communication process at the farmer level is carried out by TGT Katam as a communicator who conveys ICCIS recommendation messages to local governments and agricultural extension workers in their areas. The local government also conveys ICCIS information to agricultural extension workers after receiving information from TGT Katam. Furthermore, agricultural extension workers socialize ICCIS to farmers as the final communicant. In conveying the information, agricultural extension workers use interpersonal communication media (face to face) and plot demonstrations (demplot). Face-to-face media is a medium that is still effective because most farmer groups hold monthly meetings at least once a month. At the meeting, the agricultural extension workers conveyed ICCIS information, especially at the beginning of the planting season. This is the same as the results of [20] to facilitate technology adoption at the farmer level, it is necessary to build communication from the government and agricultural extension workers through face-to-face media, demonstration plots, technology titles, field meetings. [21] argues that the communication model built in Thailand in the context of technology adoption at the farm level is by empowering agricultural extension workers as messengers through short message electronic media. However, the results of [22] show that the elements of communication in the adoption of immersion-tolerant rice technology for climate change adaptation are agricultural extension workers, information on the quality of immersion-tolerant rice innovations, electronic communication media, and recipients of information, namely farming families. This is not in accordance with the results of this study because the types of technology messages conveyed to farmers are different. ICCIS is a technology that is in the form of a software application and does not materialize so that the benefits cannot be felt immediately.

Weaknesses and advantages of ICCIS technology can be known if there is feedback from users. The feedback from farmers is that ICCIS must be more profitable for farmers so that ICCIS can be adopted by wider farmers. Ease of being seen and observed by users is also one of the feedbacks because in general farmers will apply ICCIS if they have seen and directly observed the technology being applied by others. In addition, ICCIS will be used by farmers if it is in accordance with the norms of the system and culture in the farmer's environment. This is in accordance with the results of [23] that the technology for the green house development program has technological characteristics that are easy for farmers to adopt because it is profitable, easy to see and try, and according to the needs of farmers. [24] emphasized that in adopting innovation, the application of local wisdom or local culture of farmers is stronger than government support.

4 Conclusions

The factors that affect ICCIS implementation at the farmer level include government support through government policies, extension assistance via ICCIS socialization to farmers, and support from the ICCIS task force team, which is competent and accessible. The characteristics of ICCIS technology that are advantageous and readily observable, as well as social system variables mediated by system norms such as farmer culture and habits.

The communication model developed was carried out progressively from the ICCIS task force team to the local government and PPL, which was then continued to the farmers. The communication mediums utilized include interpersonal media and demonstrative plots. The feedback that farmers anticipate is ICCIS to make it more lucrative for farmers, simple to access, and in line with the norms and culture prevalent in the farmer's region.

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