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Research paper

Agricultural Extension Planning Based on Risk Mitigation: The Case of Land Conversion in Indonesia

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Abstract

By the massive agricultural land conversion which threatened the farming sustainability, the agricultural extension planning should not merely to improve the farming innovativeness and skill of the farmer, but it should be focused comprehensively on controlling the risk of land conversion (LCR). Therefore, the research aims to identify the event of LCR, the agents of LCR, and finally to formulate the agricultural extension planning to control the agents of LCRs. The in-depth interview with the 60 of farmer group's head in West Java, Indonesia, from June to October 2016, the research pointed out four events of LCR and seven agents of risk induced the coming of LCR, mainly in cultivation and plant maintenance phase. Based the HOR model analysis, the agricultural extension should be prioritized sequentially to implement the integrated planning of developing the skillful volunteer to work proudly in paddy-farming; high cooperation with many sides to form the opinion that rice farming is respectable; and it should highly be supported by the government program to buy the fertile farm land sold by the owners.

Key word: *the risk of land conversion, the risk agent, the agricultural extension planning, Indonesia*

1. Introduction

The critical view on diffusion of innovation model of agricultural extension has yielded the interaction and dialogue model of extension, focusses on the expanding of farmer's awareness, in which it is widely practiced in farmer field school (FFS). The extension planning in the first model is mainly to deliver innovations, practically as well as ideas. Based on this model, the research of extension was mainly to measure the farmer's innovativeness, adoption of innovation, farmer's social and economic characteristics, and attributes of innovations accelerated the diffusion of new ideas and practices [19]. While, for the latest model, represented in FFS, farmer's maturity, attitude of learners, problem solving ability are the main target of extension. The FFS extension has not been delivering the new practices from sources system to recipient, but emphasizingto extend human capacity [8]. This model has placed the farmers as the participant – in the equal position with the facilitators -- in which they got experience by self-experimenting, doing, participating and self-discovering [7]. The desire to adopt the innovation is emerging from farmer's consciousness to solve the problems in their farming activities.

The latest model has succeeded to narrow the knowledge gap and let the farmer almost equally in adopting the new practice, although the innovation gap could completely be disappeared because of the education level, basic knowledge and skill, experience, and the owned resources [9].

The dialog model of extension by self-discovery and finding – in which it is widely implemented in FFS -- indicated generally the exciting achievement and it could be the suitable model of extension, especially for relatively good educated farmer. However, this high achievement is mostly un-valuable, and contrarily the agriculture field has been facing the serious challenge because of the massive farming land use change. The 1983 agricultural census (AC) pointed out that Indonesia owned 16 704 272 ha of paddy land, but unfortunately the amount has deceased to the 8 685 888 ha in 2013 AC [10]. Within the period of twenty years, Indonesia has lost more half of wet rice field; while the Indonesian population – in which they are strongly dependent upon rice as staple food – has constantly been increasing from 158 million in 1983 jumped to 255 461 686 people in 2015 [18; 10]. In this context, FAO, IFAD and WFP [3] delivered the important note that Indonesia has failed to control the land conversion, and the country could potentially become the food unsecure state.

The massive land use change – based on the above consideration -- is the risk or even the high risk threatened the farming sustainability; and potentially will place Indonesia dealing with the risk of food crisis. The land use change is also strengthened by the young farmer tendency to leave the farming land and prefer to work outside the agricultural field. The interest of farming is merely for the old farmer, which their ages are above 50's [6]. The farmer's assumption that land selling is the proper way to solve the economic problem has paved the way to change the land allotment. More than 75% of the farmers in SubakJadi, Tabanan, Bali, Indonesia agree and strongly agree that land conversion could solve the economic problem of farmer [2]. The dynamic of development has increased the need of land for infrastructure, housing, and industrial estate; and it could be a strong pressure to complete the risk paced by the farming land in Indonesia.

By such consideration, the agricultural extension planning model should initiate the new extension paradigm, in which it is not merely to deliver the farmer's innovativeness, skill, competences, and awareness, but it should focus to plan the integrated action to solve the risk of land conversion. For that purpose, the research aimed to identify the risk of land use change in the form of farmer condition, tendency, and preference; the agent induces the emergence of risk; and finally to determine the prioritized integrated action plan to control the continuing of fertile farming land conversion. The research took the case of Cianjur farming area, West Java, Indonesia which has had a high potential to experience farming land conversion. The research also focused on the stage of cultivation and plants maintenance in the process of paddy yielding.

2. The conceptual framework and reasoning

The research presented the event for land conversion risk (LCR), the agent of risk, and the proper integrated agricultural extension planning to control the risk. The common definition of risk literally is possibility of loss, injury, unwelcome circumstances and unexpected situation. Referring to Baranoff*et al*., Maman*et al*. [11] expressed, the source of risk could probably be a natural hazard, such as volcanos and hurricane as well as the man-made condition.

The shortage of the staple food is risk for humanity. The massive land use change is a high risk for staple food availability. The farmer condition and attitude toward farming land which has led the high tendency of farming unwillingness and land selling could seriously become the event of risk. Quoted Baranoff*et al*., Maman*et al.* [11] emphasized, the scope of the risk can be categorized into the macro and the micro level based on its coverage to the national stage, individual, family, and the small company. The risk event of land conversion could probably cover the nation as the FAO's note on Indonesia [3]. The risk of the nation is, of course, a gradual accumulation of risk on all sides related to the life of the nation. Fujimoto [5], Neef [15],Nabangchang&Srisawalak [13], Susilawati&Maulana [20], which is strengthened by NDPA [14]confirmed that the Indonesian agri-food is a family farming system, which is indicated by the small size of land. The family household is responsible for staple food supply. The source of food crisis caused by wetland conversion should be detected to the risk event within the farmer families, the farmer's attitude as well as their condition.

To trace the risk has affected land conversion could be detected in the supply chain approach. Tang & Musa [21]emphasized the coherence between risk, uncertainty, and supply chain process. The two researchers stated, "risk is unreliable and uncertain resources creating supply chain interruption, whereas uncertainty is matching risk between supply and demand in supply chain process." It is true, the risk analysis, uncertainty, and supply chain are originally the subject of risk management and logistic, but it innovatively could be applied in other related field. Maman*et al.* [12]got succeeded to apply the supply chain model to explore the halal risk. Based on the experience, the supply chain approach would probably get excellent result to detect the farmer condition, attitude, behavior and tendency have induced the land use change.

The paddy production process in supply chain approach could be categorized into three stages of pre-cultivation, cultivation & plant maintenance and post-harvest phase. However, this research prefers to explore the risk event in the phase of cultivation & plant maintenance. Referring to Wstra and Mahbuby [22],the important of agribusiness risk is a high dependent upon season. In addition, the farming practice such as breeding, tillage, cultivation, and plant maintenance could be too complicated in farmer perspective [19]. The pest attack and diseases still disturb the farming process that possibly brings the farmer to get loss. The effort to control the pest and disease attack practiced in FFS has not yet gotten proper successful [4]**,** inwhich it still frightens the farmer to get loss. The above condition hypothetically will accumulate and bring out the farmer's preference, tendency, and finally land selling as the risk for food availability.

The probable risk above should be blended with the rural cultural transformation. Rahardjo [17]outlined the change of village from rural to urban life because of the economic development, accessibility, and extension of urban area. The children of the farmer which inherited the farming area have had a tendency to leave the farming life because of the coming of urban pattern along with the cultural change. The complexity of farming practice will bring the youth of village regarding that the farming is unsuitable with the emerging urban culture.

In the light of above literature review, in the cultivation and plant maintenance process, the research pointed out three risk control points (RCPs), included rough work, pest attack and depend on the season. The three RCPs are the "stone corner" to explore the condition, attitude, and tendencies as risk events for the farming sustainability.

3. The research methodology

Following the logic of House of Risk [16], this research is methodologically divided mainly into two stages. The first is majorly to specify the agents of risk – which is operationally defined as the condition or behavior induces the farmer to have a strong tendency of land conversion, and it is formulated in the form of Aggregate of Risk Potential (ARP) – need to control. The second is majorly to prioritize the integrated-agricultural extension planning to restrain the agent of risk potentially encourages the coming of land use change.

The steps in the first stages are: (1) identification of -- qualitatively by literature review, and in-depth interview -- the high potential of farmer tendency toward land conversion as a risk events, and its severity level (S_i) in Likert scale; (2) browsing qualitatively the potential agents encourage the coming of such farmer's inclination and its probable occurrence (O_i) in Likert scale; (3) determining the agent needs prioritized to restrain in the form of ARP_j presented in Pareto diagram. The formula used to define the ARPj is $O_j\Sigma_i S_i R_{ij}$: [16]

ARP_j	Aggregate of risk potential
O_j	The occurrence level of risk agent
S_j	Severity level of risk event
R_{ij}	The correlation of risk $agent_j$ to the risk $event_i$

While,the series of research methods in second stage which is visualized house of risk (HOR) model are: (1) in-depth identification qualitatively about the probable action to plan in preventing the emergence of risk agents, with its difficulty to perform (Dk) in Likert scale; (2) specify the impact of each planned action to the agent of risk (E_j) in extended Likert scale by its impact from 0 to 9 scores, in which the 0 is strongly no impact, 1-2 is strongly weak impact, 3-4 is weak impact, 5-6 is moderate impact, 7-8 is strong impact and 9 is

highly strong impact; (3) determine the total effectiveness of each planned action (TE_k) by adopting Pujawan and Geraldin model [16]in which the equation is $TE_k = \Sigma j ARP_j E_{jk}$, that means:

TE_k = Total effectiveness of each action of mitigation
ARP_j = Aggregate of Risk Potential
E_{jk} = The impact of planned action to prevent the risk agent.

The next step (4) is defining the effectiveness to difficulty ratio (ETD_k) used the following formula: [16]

$$\frac{TE_k}{D_k} \quad ETD_k$$

Where:

ETD_k = Effectiveness to difficulty ratio
TE_k = Total effectiveness of each planned action
D_k = Degree of difficulty to perform the planned action

Based on the ETD_k, the research comes to (5) determine the rank of priority of the agricultural extension planning. To implement the two main stages of methods, the research took the place of Cianjur farming area, West Java, Indonesia which has had a strong potential of land conversion [1]. The research took 60 people of farmer group heads as key informants, which strengthened by the data from the Agricultural Service District (ASD) in local context. Data collection was conducted during June-October 2016.

4. Result and discussion

4.1. The Land Conversion Risk and Its Agents

The land conversion risk (LCR) in this context is the assumption, behavior, and the condition induced the tendency of the farmer to leave the farming land, to sell and to convert the land into other usages. To browse the LCRs, the research was assisted by the three risk control points (RCPs), in which the paddy farming is rough work, get highly probable pest attack, and depend on season. The in-depth interview was based on thisthree RCPs.

In the light of the first RCP, the research has successfully collected five LCRs. By the second RCP, in-depth interview has acquired three LCRs, while the third RCP directed to define thee LCRs. From the eleven LCRs (Table 1), the research revealed the four major risks, indicated by the high score of its severity level (S_i). In the first RCP, the farmer has a tendency to sell farming land and work outside agricultural field. The second RCP has encouraged the farmer to get a farming unwillingness due to the difficulty to watch the pest and plants disease. The second RCP itself has motivated the farmer to sell the farming land and work outside the agricultural field due to the risk of pest and disease attack. In the light of third RCP, the probable risk of draught has led the farmer to get farming unwillingness (Table 1).

By in-depth interview with the farmer group heads, the research has also revealed ten main agents of LCRs -- in which it is the condition, behavior, and facts that have induced the coming of LCR threatened the farming sustainability – indicated by the high score of each occurrence level (O_i).

Based on the data presented in Table 1, the assumption that selling land is a problem solving for the farmer has induced strongly the land selling tendency and work outside the farming land, and of course the existence of this agent is under pressure of other development sector fought the land area over. The less skill of pest management has caused the farmer to feel farming unwillingness due to the difficulty to watch the pest. The lack assurance of losses due to pest and plant disease attack has motivated the farmer that land selling and work outside farming is better. Finally, the inadequate watershed infrastructure has led the farmer to have a farming unwillingness because of the frequent of the draught. In general,the coming of LCR has been caused by physical, socio-cultural, and socio-economic factors.

4.2. The land conversion risk level

The agricultural extension should strongly be focused to control and to change the agents of risk, and it automatically will reduce the probable coming of LCR. The research -- for such purpose based on the severity level of risk (S_i), the occurrence level of the agents (O_i), and the impact level of risk agent to the emergence of risk event (R_i) -- has identified seven agents, which has accumulated 77% of LCR. In the light of this model analysis, the agent of LCR was visualized in the form of aggregate of risk potential (ARP), and presented in Pareto diagram (Figure 1).

The above process has revealed that the top rank of the agent by its 16% contribution to the LCR is the less skill of pest management (A6). The second rank is the lack of assurance for the farmer's losses because of the pest and plant disease attack (A8), contributed 13% to the LCR. The third and fourth agent which each contributed 11% for the LCR is the unstrict regulation to prevent the agriculture wetland draying (A11); and the assumption that working on the non-agricultural sector is more respectable (A2).

Table 1: The Land Conversion Risk in Cultivation and Plant Maintenance

RCP	Code	Land Conversion Risk	S_i	Code	Land Conversion Risk Agent	O_i
Rough Work (RCP4)	R-1	Unwilling to farm because it needs physical hard work.	4	A-1	The lack of appropriate technology to reduce physical work	7
	R-2	Unwilling to farm due to dirty and muddy	4	A-2	The assumption of working on the non-agricultural sector is more respectable	7
	R-3	Unwilling to farm because farming is for poor and unprivileged people	1	A-3	The suspicion of strongly low dignity of farmer	5

	R-4	Unwilling to farm because it is merely for low educated people	4	A-4	The presumption of inappropriate farming for the higher educated people	7
	R-5	Better to sell the land and work outside the agricultural sector	7	A-5	The assumption that selling land is a problem solving for the farmer.	7
Pest attack (RCP-5)	R-6	Unwilling to farm due to difficulty to watch the pest	7	A-6	The less skill of pest management	7
	R-7	Unwilling to farm because of the risk of pest and disease attack	5	A-7	The inadequate skill of healthy rice cultivation	7
	R-8	Better to sell the land and work outside farming due to the risk of pest and disease attack	7	A-8	The lack assurance of losses due to pest and plant disease attack	7
Depend on Season (RCP-6)	R-9	Unwilling to farm because of the risk of draught	7	A-9	The inadequate watershed infrastructure	7
	R-10	Unwilling to farm and better to work outside cultivation than the frequent of draught	5	A-10	The inadequate infrastructure of water storage	7
	R-11	Better to sell the land because the land has been dry, and there is no irrigation facilities	3	A-11	The unstrict regulation to prevent the agriculture wetland draying	7

In addition, the research also pointed out three agents in which each contributed 9% to the emergence of LCR. The three agents are: the inadequate of appropriate technology to reduce the physical work (A7); the inadequate of healthy rice cultivation skill (A14); and the assumption that land selling is a problem solving for the farmer (A15). By controlling the seven agents of risk, the agricultural extension will effectively mitigate the probable emergence of the risk. Based on the presented agents, the agricultural extension should be prioritized to control and to reduce the emergence the seven agents of LCRs. Therefore, the agricultural extension will yield the measurable result.

4.3. The Priority of Agricultural Extension Planning

The literature study, FGD, and in-depth interview have acquired ten probable actions to perform as the agricultural extension planning(Figure 2). But, it is impossible to implement all the proposed actions. In this context, by the House of Risk Model (HOR) analysis, the research formulated the prioritized actions.

By considering the ARP and the impact of the action to control the agent f LCR (E_{jk}) – and based on above formula (See the research method) – the research has defined the total effectiveness of the action (TE_k). For further step, the research considered the degree of difficulty to perform the action (D_k) and TE_k to acquire the Effectiveness to difficulty ratio (ETD_k), in which it was operationalized in the previous equation (See the research method) and visualized in HOR-2 model analysis (Figure 2).

In the light of ETD, the research has decisively suggested the government to buy the fertile farming land sold by the owner as part of the main agricultural integrated extension planning. Sequentially, the development of skillful volunteer farmer to work proudly in paddy farming is an evitable extension planning. Fortunately, this planning is closely related with the program of extending the pest management skill and the healthy paddy farming management skill, in which the two last programs have also been proposed as part of agricultural extension planning (Figure 2). This proposed planning should strongly be assisted by developing high cooperation with many sides to form the opinion that rice farming is respectable.

The three main previous planning should be supported by the assurance system to avoid the loss of the farmer due to the pest and plant dieses attack. For this purpose, optimizing the loss assurance of the farmer has gotten the fourth prioritized planning based on its ETD (Figure 2). While, the fifth and the sixth planning – in which they are extending the pest management skill and healthy paddy farming management skill – have been included in the second planning because it is closed connection with the second priority of agricultural planning.

In addition, the optimizing the use of appropriate technology to reduce the physical work should specially be planned to maintain the farming interest and to prevent the high tendency of farmer to leave the farming field, especially within the young farmers who will be inherited the farming land. Based on its ETD, this planning has gotten the seventh priority (Figure 2). However, the compatible technology to reduce the physical work could be less-valuable unless it is supported completely by watershed facilities as the major requirements for farming practice. In this context, repairing and improving the irrigation amenities could be inescapable as part of integrated agricultural planning. Based on its ETD, the providing of watershed facilities got the eighth rank of priority. However, this proposed planning is closely connected with the compulsion of providing the water storage in rainy season, and in turn it could easily be used in dry monsoon. Based on this plan, the Government should declare the rule to prohibit drying out the technical irrigation farming land. The two last proposed agricultural extension planning got the rank of nine and ten in the light of each ETD.

For more clear, the extension planning – based on its rank of priority – is divided into two main parts. The first is related to the policies in which the government has to preserve the agricultural land, but it is not by suppressing the farmer not to sell their own land, but the government has to buy the land sold by the owners. In this context, the government has to initiate the institution to manage the government owned fertile paddy-farming land in the center as well as the local government; and the government has also to control the rice distribution entirely from center lo local level. The other policies are to insure the harvest fail, to provide and maintain the watershed facilities, and to issue the rule to prohibit the technical-irrigation-fertile land draying.

The second parts, in which it is grouped into the pure extension planning to build the human capacities, are to develop the healthy farming skill, to control pest and plant disease, and to feel respectable in farming process and cultivating and farmer status. The second part could widely be practiced in farmer field school. By this model of planning, automatically, the agricultural extension planning will get more integrated program and measurable impact.

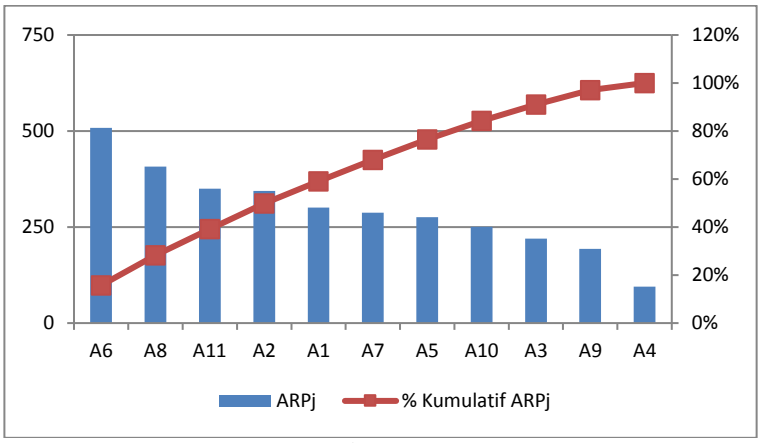
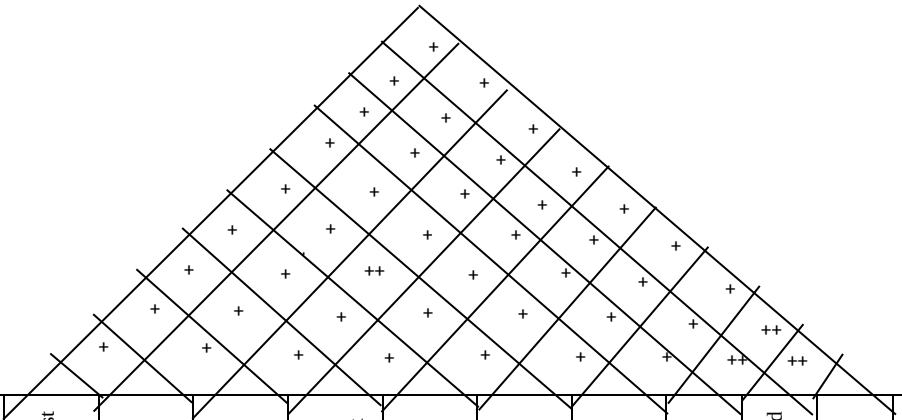


Figure 3: The Aggregate of Risk Potential in Cultivation Process



Proposed agricultural extension planning / Risk agent to control	Code	Optimizing the loss assurance of pest and plant disease attack	Developing the skillful volunteer to work proudly in paddy-farming;	Extending the pest management skill;	Optimizing the use of appropriate technology to reduce the physical work	Developing high cooperation to form the opinion that rice farming is respectable	Extending the healthy paddy farming management skill	Government buying the fertile food farmland that sold by the owners	Government providing water storage facilities in rainy session	Repairing and improving the watershed facilities	Prohibiting of drying out the technical irrigation farming land	
	Code	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9	M-10	ARP_j
The lack of appropriate technology to reduce physical work	A1	9	1	1	1		1	1				301
The assumption of working on the non-agricultural sector is more respectable	A2	1	9	9			1					287
The assumption that selling land is a problem solving for the farmer.	A5		1	1	3	1	1	1		1		276
The less skill of pest management	A6	1	3	1	1	3	3	9	1	1		251
The inadequate skill of healthy rice cultivation	A7	1	3	1	1	9	3	3	1	1		220
The lack assurance of losses due to pest and plant disease attack	A8	1	1		1	9	3	9	1	1	1	193
	A11				1			1	9	3	9	95
	TE_k	3 660	4,766	3631	1,793	4,746	2, 856	5,233	664	940	193	
	D_k	5	5	5	5	5	5	5	4	4	5	
	ETD_k	732	953	726	359	949	571	1,047	166	235	39	
	Rank of Priority	IV	II	V	VII	III	VI	I	I X	VIII	X	

Notes: + = no connection between each action
++ = connected between each action

Figure 2: The House of Risk Model to PrioritizeAgricultural Extension Planning

5. Conclusion

1) The agricultural extension model has gotten the rapid development and change from the diffusion of innovation -- in which the farmers are the recipient – to the model of dialogue, self-experiencing, learning by doing practiced widely in farmer field school. However, based on the fact of farmer changing and threatening the farming sustainability, the farmer maturity development should be focused on controlling the risk;
2) The process of agricultural extension – based on risk mitigation – could be implemented in three stages: identification of risk events lead the land use change within the famers, defining the agents of risk induces the emergence of risk events; and finally deciding the sequences of agricultural extension planning to manage and to mitigate the risk agents.
3) In the case of Cianjur farming area, Indonesia, the research found four major farmer conditions and preferencesas risk events threatened farming sustainability in cultivation and plants maintenance process, which includes: (a) unwilling to farm due to difficulty to watch the pest and plant disease and (b) because of the risk of draught; (c) farmer's preference to sell the land and work outside the agricultural field; and it is mainly because of (d) the risk of pest and disease attack;
4) Based on the severity level of risk, the occurrence level of risk agents, and the impact of risk agent to risk event, the research revealed seven agents contributed more than 70% to the coming of the event of LCR, which includes: (a) insufficient of pest management skill, (b) Inadequate assurance for farmer's losses because of pest and plant disease; (c) unstrict regulation to prevent the agriculture wetland draying; (d) assumption that working on the non-agricultural sector is more respectable; (e) inadequate of appropriate technology development to reduce the physical work; (f) the less skill of healthy rice cultivation; and (f) the assumption that land selling is the problem solving for the farmer.
5) In the light of HOR model analysis, the agricultural extension needs the government policy support, which included: (a) optimizing the assurance for harvest fail, (b) developing the appropriate technology to reduce the the physical work; (c) buying the fertile food farm land sold by the owner; (d) Providing and repairing the watershed facilities, and prohibiting of drying out the technical irrigation farming land. In addition, it needs the capacity building of farmers, which includes: (a) development of respectable feeling to work in paddy cultivation, and a status of the farmer; (b) extending the pest management skill and healthy paddy-farming management skill.

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