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Article

Between environmental performance and agricultural productivity : assessing the convergence and divergence of demand-driven agricultural extension

International Journal of Energy Economics and Policy

Provided in Cooperation with:

International Journal of Energy Economics and Policy (IJEEP)

Reference: Tri Widayati/Waridin Waridin et. al. (2019). Between environmental performance and agricultural productivity : assessing the convergence and divergence of demand-driven agricultural extension. In: International Journal of Energy Economics and Policy 9 (4), S. 158 - 165.
<http://econjournals.com/index.php/ijEEP/article/download/7688/4416>.
doi:10.32479/ijEEP.7688.

This Version is available at:
<http://hdl.handle.net/11159/4947>

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Environmental Performance and Agricultural Productivity: Assessing the Convergence and Divergence of Demand-Driven Agricultural Extension

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Received: 14 February 2019

Accepted: 21 May 2019

DOI: <https://doi.org/10.32479/ijee.7688>

ABSTRACT

This study aims to analyze and evaluate the implementation of agricultural extension on bridging the critical point between environmental performance and agricultural productivity based on community needs and the role of agricultural extension in increasing productivity, reducing the number of poor and environmental degradation. This research uses sequential mixed method with stakeholder analysis and descriptive statistics. This research was conducted on 31 samples of farmer groups in Kejajar Subdistrict, in Dieng plateau area, Central Java Province. The results showed that the level of effectiveness of farmer group participation was classified as medium. The role of stakeholders and academics is still low, but the role of agricultural extension officers is relatively high because they are more responsive to the farmers' needs. The implementation of agricultural extension in Dieng area has not fully utilized demand driven basis due to institutional and regulatory factors that have not fully supported the role of agricultural extension officers in the field. In addition, it is also found that the competence of agricultural extension officers is still low so that they have not been able to carry out demand-driven extension function.

Keywords: Agricultural Extension, Potato Farming, Demand-Driven, Food Productivity, Environmental Quality

JEL Classifications: O13, Q16

1. INTRODUCTION

Agriculture has greatly contributed to farmer household income, food security, and food supply on the market. However, agriculture also contributes to environmental destruction (Pretty et al., 2003). Efforts solely aimed at increasing the effects of the agricultural economy are often faced with deforestation and degradation of the quality of the soil, water and air environment (Zambrano-Monserrate et al., 2016; Smagulova et al., 2017; Scherr, 1999). This is a critical point, and serious efforts are needed for stakeholders to bridge the interests of improving both agriculture productivity and environmental sustainability (Tschamntke et al., 2012). For developing countries, the causes of

deterioration in environmental quality are often borne by groups of farmers who are considered to be environmentally unfriendly, and less aware of the carrying capacity of the environment due to low education and economic resources they have (Manan, 2015). Here, the critical role to improve agriculture and environmental sustainability is given to field extension workers (Gebremedhin et al., 2006). The role of agricultural extension in farming is to increase farmers' knowledge and skills and then use them to improve crop yields. Appropriate agricultural extension combined with the use of advanced and appropriate technology will affect overall crop yields, but extension programs confront both internal and external constraints. Internal factors include high poverty and low education among farmers while external

factors comprise the difficult geographical conditions, poor transport infrastructure and lack of farm equipment. These internal and external factors trigger the emergence of different acceptance among farmers on the performance of agricultural extension officers. Farmers' satisfaction and dissatisfaction on this performance lead to different crop yields (Baloch and Thapa, 2018).

Potato production in Indonesia has increased significantly during the period of 2011-2014. In 2014 there was a significant increase in total production compared to the previous year, from 1,124,282 tons to 1,347,815 tons. The comparison of total production between Central Java and Indonesia can be seen in Figure 1.

Figure 1 shows the contribution of potato production from Central Java ranks second after West Java Province. The total supply of potatoes produced by Central Java Province supports the consumption needs of the community where the rate of consumption per capita of Indonesian population grew by an average of 12.57% during the period of 2011-2015, from 1,564 kg/capita/year to 2,294 kg/capita/year. The supply of potatoes in Indonesia was 1,043 tons in 2011, and 1,213,038 (Ministry of Agriculture of Indonesia, 2016). Dieng mountainous area administratively covers 6 regencies, namely Kendal, Batang, Temanggung, Wonosobo and Banjarnegara. The elevation of the Dieng area which reaches >1500 m above sea level makes it an area that is technically eligible for potato planting. Banjarnegara Central Bureau of Statistics states that the production of potatoes in Dieng reached 531,817 quintals with Kejajar subdistrict as the largest producer.

Potato production potential in Dieng mountain area is relatively high and not yet optimal. This production can still be improved by actively involving all stakeholders. Departing from the problem, the purpose of this study is to analyze and evaluate (1) the implementation of agricultural extension based on community needs, (2) the role of agricultural extension officers in increasing productivity, reducing the number of poor and environmental degradation.

2. LITERATURE REVIEW

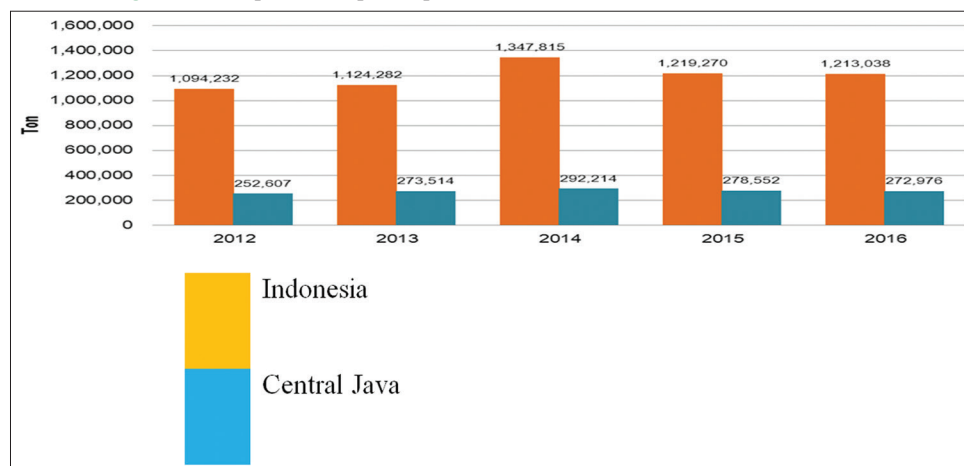
2.1. Agricultural Extension

Agricultural extension is done to improve farmers' knowledge and skills so that they can produce better crop yields. Better seed use, newer science, and more advanced technology will have an impact on crop yields. Agricultural extension has several constraints such as low number of extension officers, reluctance of farmers who have become accustomed to old production patterns, high poverty and low education of farmers, lack of supporting equipment and poor infrastructure and transportation (Baloch and Thapa, 2018).

Extension has an important role to provide group-based services with the aim of helping people to be able to help themselves through knowledge and understanding of connecting technology to the needs and opportunities that farmers have. Agricultural extension is important in increasing food production and self-sufficiency (Singh et al., 2009). Various studies on agricultural extension indicate that participatory extension services have resulted in optimism in farmers' knowledge and skills as well as improvements in production. Evaluation of the extension program success focuses on the farmers, as it includes behavioral changes in the adoption of increased use of production inputs, production output, income and impact assessment of farmers' standard of living. The success of the extension program always goes both ways from the side of the farmers and the extension officers themselves (Agbarevo and Benjamin, 2013).

Indonesian government passed Law No. 16 of 2006 (Republic of Indonesia, 2006) and presidential regulation No. 154 of 2014 on agricultural, fisheries and forestry extension institutions in order to support the existence of agricultural extension institutions (Government of Indonesia, 2014). The government policy is the legal umbrella in strengthening the role of agricultural extension officers as they become one of the main parts in the development of farming and increasing yields. The role of large agricultural extension in increasing production and encouraging the demand for potato products in Dieng area is very important.

Figure 1: Comparison of potato production between Central Java and Indonesia



2.2. Productivity and Environmental Issues

Agricultural extension is a learning process for the target community so that they are willing and able to help and organize themselves in accessing market information, technology, capital, and other resources, in an effort to increase productivity, business efficiency, income and welfare, and increase awareness in preserving environmental function (Ngwira et al., 2014; Duvel, 2000). Law No. 16 of 2006 on agricultural and fisheries extension system states that agricultural extension is a learning process for the main actors and business actors so that they are willing and able to help and organize themselves in accessing market information, technology and capital, and other resources, in an effort to improve productivity, business efficiency and income, and welfare, as well as raising awareness in preserving environmental functions (Prabowo, 2014).

Agricultural extension faces the challenge of building a well-managed, effective, and accountable system that meets the needs of farmers involved in diverse and complex farming systems. Such problems are related to the monitoring and evaluation of extension services and their impact assessment, the extension dependence on the performance of the agricultural research system and their feedback linkages, and the inherent problem of ensuring political commitment and fiscal accountability for agricultural extension. Singh et al. (2009) argues that agricultural extension is necessary to provide real information, measurable value, demand driven and customized information (Singh et al., 2009). Major reform trends around the world include decentralization, contracting, privatization, cost recovery, and the involvement of NGOs and farmer-based organizations (Rivera et al., 2001). Emphasis is now placed on demand-based extension services. This emphasis needs to be seen in the context of changes in the domestic and external environments for agriculture, which alter the information needs of farmers. In addition to information on new technologies, advice on marketing, product quality, and environmental challenges are becoming increasingly important.

2.3. Demand-Driven Extension

Friederichsen et al. (2013) in his research in Vietnam identified that agricultural extension officers are strategic actors who can maneuver in the ongoing institutional change in socialist government. Shahbaz and Ata (2014) found an increase in agricultural extension effectiveness in Pakistan after the post-devolution implementation to the local government, which began in 2001. The research on agricultural extension performance has been done by various researchers with different variables. Performance is assessed from the program, availability of technology, training, farmer attitude and farmer participation, including external factors such as motivation and skills of extension officers. Agricultural extension in the era of regional autonomy faces several obstacles, among others: (1) differences of views between local government and members of the Regional People's Legislative assembly in understanding agricultural extension and its role in agricultural development, (2) small allocation of local government budget for agricultural extension activities, (3) the availability and support of agricultural information is very limited, and (4) the deterioration of extension officers' managerial capacity (Shahbaz and Ata, 2014). Agricultural extension in the era of regional autonomy will be more

participatory to enable farmers and their families to manage their own farming business independently (Charina, 2015).

Demand-driven refers to the concept of supply and demand. Economic theory states that demand refers to the amount of goods or services that consumers want and can afford at a certain price. This research departs from the market failure especially affecting the demand and supply of agricultural sector. The main cause of this failure is allegedly because traditional patterns still have an important role in the culture of community cultivation, including aspects of production, financing and marketing. This failure has led to demand for agricultural extension, training and mentoring systems being one of the top-down models in supply driven patterns.

A research in Pakistan shows that a demand-based approach, initially introduced for extension services, is being used by community organizations that demand multi-disciplinary services for their development. Regardless of the doubt, both men and particularly women have been empowered by adopting grassroots planning mechanisms. This is evident from their strong motivation to create local NGOs, Clusters and local support organizations in the villages as well as from active and constructive dialogue between government officials and community representatives at regency-level meetings on a regular basis. In some cases, regency-level government officials have found the conditions somewhat uncomfortable due to strong intervention by community representatives, especially women (Shahbaz and Ata, 2014).

The demand-driven extension approach was introduced structurally by the FAO TCP/PAK/2905 pilot project, "Strengthening extension capacity for community-based demand planning for natural resource management in Jamad and Kashmir Azad Region." FAO uses the following nine main components, which are demand-driven extension approaches: (1) community-based processes for preparing plans, (2) community organizations, (3) gender sensitive training modules on key topics related to grassroots planning (5) capacity building, training and/or stakeholder orientation in grassroots planning, using training modules and audio visual aids, (7) plans to serve the demand, (8) delivery plan, and (9) participatory monitoring and impact assessment of the delivered services (Qamar, 2011).

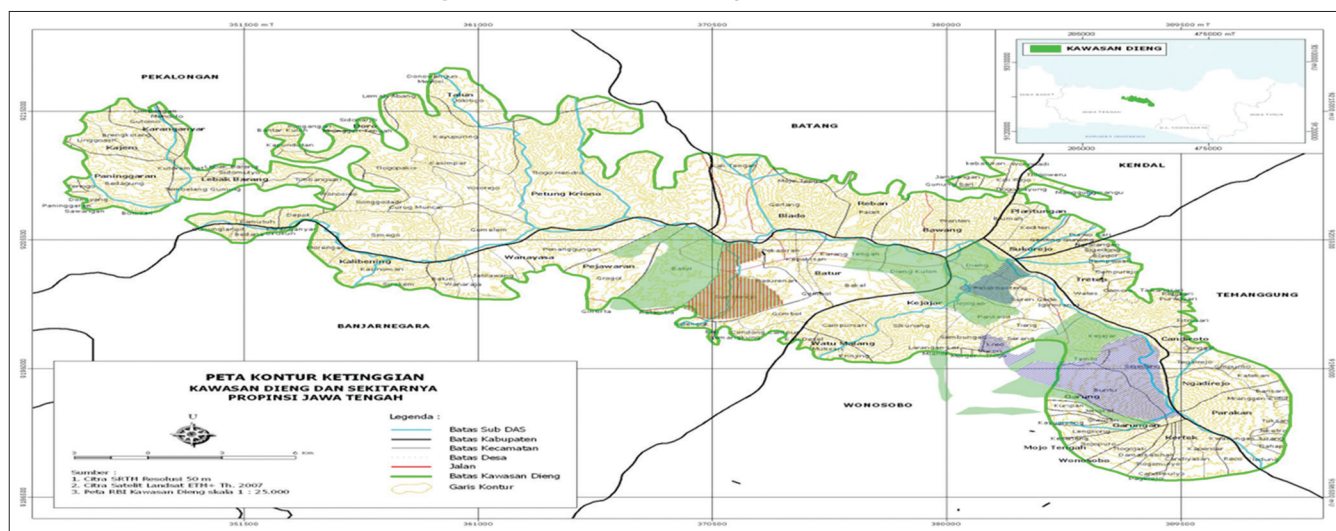
3. MATERIALS AND METHODS

3.1. Research Design

This study uses primary and secondary data. Primary data were obtained from 200 farmer respondents belonging to 31 farmer groups, agriculture department, village community empowerment office and agricultural extension officer. The data was collected through in-depth interviews of agricultural extension officers, farmer groups, agricultural offices, village community empowerment offices, documentation and focus group discussion.

3.2. Research Participant

Stakeholders involved consist of agricultural extension officers, farmer groups consisting of 31 groups divided into 3 groups - Farmer group 1 considers agricultural extension officers

Figure 2: Research sites in Dieng area, Central Java Indonesia

unable; Farmer group 2 considers agricultural extension officers fairly capable and farmer group 3 considers highly capable agriculture extension officers, - academia, agricultural extension officers, government represented by agricultural service and village community empowerment offices.

3.3. Data Analysis

The analytical method used is a descriptive qualitative analysis which consists of how farmers participate in the success of demand driven agricultural extension, and assesses the effectiveness of farmer groups and the role of stakeholders related to agricultural development. The tool used is descriptive statistics. The second analysis is stakeholder analysis to see how the interrelationships between actors and objectives are taken: The direction of convergence and divergence to assess their respective roles. The objectives used are the nine main components applied by FAO, translated into the following nine objectives: (1) planning, (2) organization, (3) training modules, (4) equipment, (5) institutional mechanisms, (6) capacity building/training, (7) service to outsiders, (8) marketing, and (9) impact evaluation. The data is then analyzed using matrix alliances conflict tactic objective and result (Mactor).

3.4. Research Location

The study was conducted in Dieng area in two regencies, namely Wonosobo and Banjarnegara, with a sample of 31 farmer groups (Figure 2).

4. RESULTS

4.1. Source of Information

Potato is an important and main commodity in Dieng area, Central Java, and farming has been going on since 1970s. Potato farming in Dieng area shows a decrease in productivity caused by decreasing of soil fertility due to excessive use of fertilizers and pesticides. This condition causes problems to the environment, so this is where agricultural extension officers play a role to raise awareness in the environmental sustainability and productivity increase that can encourage demand.

Table 1: Information on agricultural environmental concepts

Source	n (%)
Agriculture office/officers	14 (45.18)
Formulator	4 (12.90)
Head of farmers group	3 (9.67)
Peers	4 (12.90)
Internet	4 (12.90)
Books	2 (6.45)
Total	31 (100)

Information on the need to protect the environment to support increased productivity is understood by farmer group respondents. This can be seen in the following table.

Table 1 shows that agriculture extension officers/agriculture office have an important role in providing information about the need to protect the environment to increase productivity. The environment is very important in the productivity of the agricultural sector, because the economic conditions have forced farmers to keep planting potatoes with the risk of environmental damage. Large market demand is also one factor. Another important factor is farmers' understanding that handling environmental damage is the government's rather than their responsibility.

4.2. Training Participation

The second indicator in assessing roles is how farmers participate in farm-related training. Training becomes an important variable because it is very useful to improve the performance of farming. 25% of the respondents stated that they had attended the training held by the agriculture agency while 75% of the farmers stated they had never attended the training. After the in-depth interview, the training participation is influenced by the limited budget so that it is prioritized for farmer group management so that they can transfer their knowledge to other members.

4.3. Organization Participation

Participation in organization is an indicator because it is one of the things that can increase farmers' knowledge to improve their skills and knowledge in managing potato farming. Agricultural

extension officers will undertake the task of providing information through farmers who are members of farmer groups. In addition to being a member of farmer groups, most of the respondents participate in religious organizations. The strong religious life in Dieng area is seen from the strong participation of respondents in religious organizations. Based on interviews with respondents, it was found that this religious organization also developed into a farmer group organization, which also discusses agriculture issues. The participation of farmers respondents in organization are shown in Figure 3.

4.4. Farmers group effectiveness

Field extension officers are often considered to know only theoretically but are not able to solve technical problems faced by farmers. Farmers state that many officers are not from the agriculture major, so they assume that the quality of human resources is still far from what is expected. The farmers' attitude in the research area made it difficult for the field extension officers to do their job optimally. Farmers and farmers groups are their end users. Based on their assessment, the extent of effectiveness of extension delivery is determined by the farmers' adoption and concern to implement it. The results of the Nigerian study suggest that extension failure is due to poor delivery mechanisms, lack of utilization of equipment and technology, and lack of innovation sustainability. Other important factor are the training and the organizations that are followed by the farmers (Agbarevo and Benjamin, 2013).

The government's approach is to organize farmers through farmers groups. These groups serve to facilitate coordination and interaction among members, cooperate, organize training, distribute aid and become a forum for discussion and problem solving. Village-level farmer organizations found in the research area consist of farmers groups, women farmers groups and joint farmers groups. The characteristics of these groups are: (a) informational with geographic proximity as a unifier; (b) knowing each other, familiar and trusting each other among members; (c) having the same views and interests and objectives in the business; (d) having similarities in tradition, type of business, socioeconomic status, culture and customs.

Farmer groups and joint farmers groups are formal organizations formed intentionally, whose members clearly have agreed rules (e.g., Articles of Association and Bylaws), registered in the Government and legal. The role of leadership is one determinant of an organization success. The survey conducted in the research area showed that farmers' organizations consisting of farmers groups and joint farmers groups were quite large, but only two farmers groups were legal entities while others had no legal entity and some were just names and inactive.

Factors used as indicators for assessing farmers groups effectiveness are farm productivity per hectare, farmers groups motivation, and level of satisfaction toward farmers groups. Based on calculations with predefined scores, the following results are obtained:

Table 2 show that farmer group effectiveness level in research area represented by 31 farmers groups from Wonosobo and

Banjarnegara was medium category because 87.09% farmers groups have scores ranging between 23.4 and 32.6. Only two farmers groups have a high level of effectiveness and similarly two groups have a low level of effectiveness.

The level of productivity shows a low category, where 80.65% of farmer groups had scores ranging from 4.0 to 6.7. This indicates that there has been a decrease in productivity that has been demonstrated in the preceding analysis, where in the 1980-2015 periods there was a large decline, from 40 tons per hectare to an average of 15 tons per hectare. The farmers' groups satisfaction rate showed a medium category because the largest percentage was in the range of 10.1-14.1, where there were 16 farmer groups. The motivation of farmers groups was very high, where 90.32% farmers groups felt excited with the activities in the groups.

4.5. Assessment of Stakeholders' Role

In addition to agricultural extension officers, stakeholders related to agricultural development in the Dieng area are the agriculture agency, the village community empowerment body, academics, farmer groups and agricultural extension officers. Ethiopia's research results indicate a change of new actors and relationships between actors and policies that affect the way small and poor farmers access and use information and knowledge, but the impact on their well-being is not yet known. A second finding indicates that extension and public administration have a strong influence on small famers' networks that potentially increase the potential of market-based communities and improve useful innovation processes (Spielman et al., 2011). Mactor processing shows the result of dependency and influence analysis.

Figure 4 shows that academics are stakeholders with low dependence and high enough influence to be independent. Stakeholders with high but interdependent influence are farmer group 2, farmer group 3, agriculture department, village

Figure 3: Respondents' participation in existing organizations

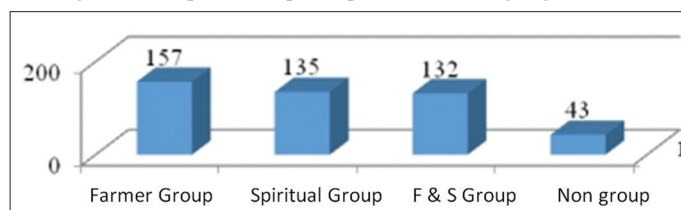


Table 2: Farmers groups effectiveness

Measures	Category	Score	n (%)
Productivity	High	9.6-12	-
	Medium	6.8-9.5	6 (19.35)
	Low	4.0-6.7	25 (80.65)
Members' satisfaction level	High	14.2-18	4 (12.90)
	Medium	10.1-14.1	16 (51.61)
	Low	6.0-10	11 (35.48)
Motivation	High	9.6-12	28 (90.32)
	Medium	6.8-9.5	3 (9.67)
	Low	4.0-6.7	-
Effectiveness	High	32.7	2 (6.45)
	Medium	23.4-32.6	27 (87.09)
	Low	14.0-23.3	2 (6.45)

community empowerment agency and agricultural extension officer, while those with low influence and high dependence are farmer group 1. This is because they are a group that does not participate in the organization and also do not believe in extension. The mapping results of these influences and dependencies will show the level of competitiveness of each actor.

Figure 5 shows that the actors with the highest competitiveness are academia, farmer group 3 and agricultural extension officer, while those with the lowest competitiveness are farmer group 3.

Stakeholder analysis also shows convergence and divergence, where there are three convergence and divergence orders. However, this study will only discuss order 3, namely convergence and divergence that has incorporated a combination of actors and objectives. The order 3 convergences show alliances and hierarchies between actors at once in the same objective.

Figure 6 shows that the strongest alliance was formed between academic actors, farmer group 3 and agricultural extension officers, in which academics became the center. Strong alliances were formed between academia with farmer groups 2, village community empowerment body and academics with agricultural services as well as agricultural extension officers. A moderate alliance is formed between the agricultural service and the village community empowerment body and the extension officers. The

weak alliance was established between the village community empowerment body and the farmer group 2. Meanwhile, farmer group 1 had the weakest relationship with all the other actors because they believe that agricultural extension officers do not have the ability to provide adoption and transfer of knowledge. Figure 6 shows the role of academics as the main actors in the agricultural development program of potato through agricultural extension process.

The mactor analysis tool also shows the relationship of divergence between actors with each objective. The order 3 divergence relationship illustrates the conditions of conflict and degree of conflict based on the contradiction of its objectives.

Figure 7. shows consistent results between divergence and convergence in which farmer group 1 had potential conflict with almost all existing actors. The strongest conflict was with academics followed by fairly strong conflicts with agricultural extension officers and moderate conflicts with farmer groups 3. Weak conflict occurred between farmer group 1 and agricultural agency, while very weak conflict is with the village community empowerment body and farmer group 2.

5. DISCUSSION

5.1. Implementation of Agriculture Extension Officers Policy

Based on the agricultural extension policy applied, it shows that agricultural extension officers are accepted by most farmer groups, although there is one group of farmers who have different views. Cooperation among actors is enough to support success in the process of increasing production through agricultural extension. Academics as external actors will be central in the success of this extension program. The results of in-depth interviews show that academics are important because they are related to commitment in research and dedication conducted in Banjarnegara, especially Dieng area.

5.2. Extension Officers Human Resources

Agricultural extension officers are functional officers who must be able to inform farmers accurately and correctly, so that this transformation will ultimately improve farmers' ability to improve the quality and quantity of their farms. Agricultural extension

Figure 4: Map of Influence and dependency between actors

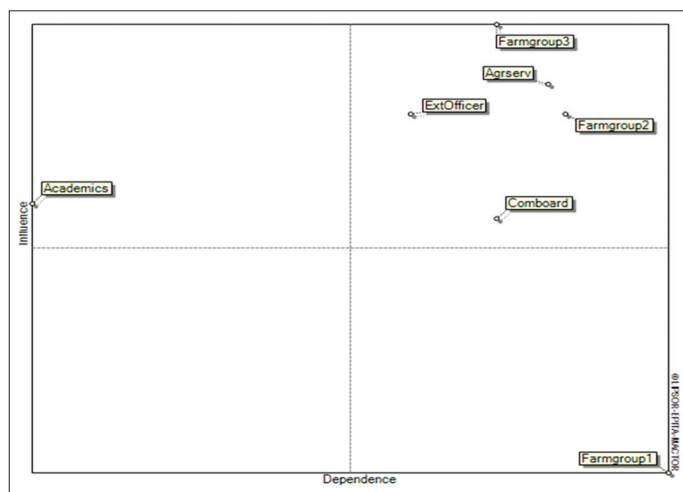


Figure 5: Competitiveness histogram

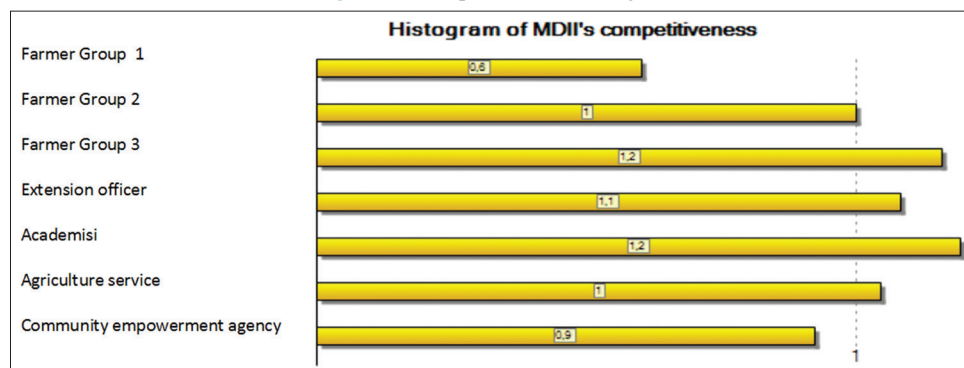
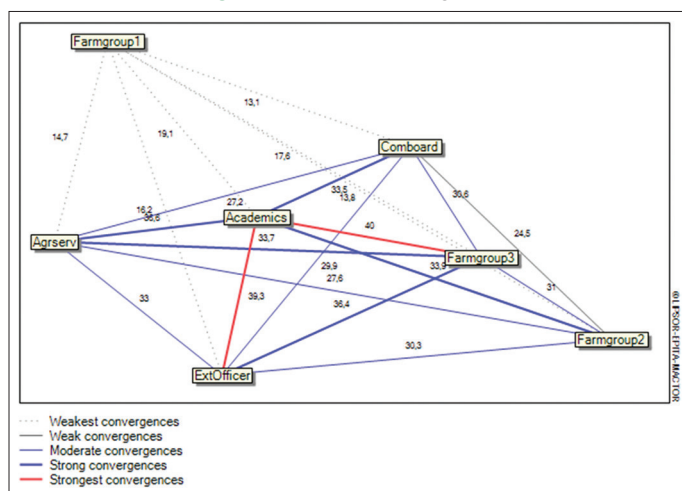
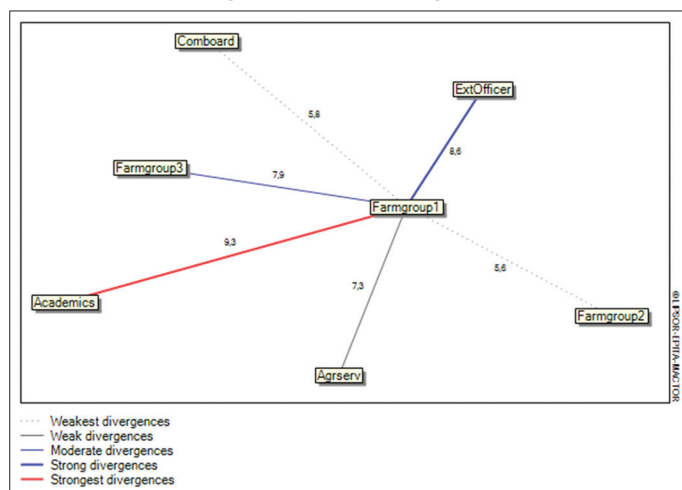


Figure 6: Order 3 convergences**Figure 7:** Order 3 divergences

officers are mostly not from agricultural education and there is not much formal education available that increases their competence. Important efforts undertaken to improve the role of agricultural extension officers are through cooperation with universities in capacity building, module preparation, utilization of appropriate technology and the use of various internet-based marketing media.

5.3. Extension Officers Institution

Based on the mandate of Law No. 16 of 2016 on agricultural extension systems, the role of extension officers is not only as a delivery system for information and technology but also as a system that serves to create agriculture as a profitable business for farmers, so extension officers should be agribusiness oriented. The purpose of extension is the development of human resources and the improvement of social capital, which means that agricultural extension officers should have a broader focus than mere attitude, knowledge and skills of farmers. Agricultural extension officers who are part of the agricultural agency must be actively involved in the empowerment of farmers with village community empowerment bodies and active in both formal and informal farmer groups organizations.

In drafting the extension strategy, the central government and local governments need to pay attention to extension policies involving stakeholders in agriculture, fisheries and forestry.

6. CONCLUSION

Implementation of agricultural extension in Dieng area has applied a demand-driven basis although not yet optimal because there is still one group of farmers which cannot accept the role of agricultural extension officers. Agricultural extension officers should be able to encourage participation in the organization as one of the leverage tools for the farmers groups involved. The competence of agricultural extension officers is sufficient to encourage demand for potato production. Agricultural extension strategies that can increase demand are (a) enhancing the capacity of farmers groups through enhancing the competence of extension officers in the implementation of extension programs, (b) raising awareness of extension officers in utilizing extension media including module preparation, appropriate technology tools, mechanism and marketing development to become drivers in terms of marketing, (c) enhancing the capacity of extension officers to tasks through enhancement of functional competence i.e., capacity building, (d) increasing the active participation of the community through participation of farmers groups in participatory, democratic and continuous organization, (e) increasing the role of cooperation with the education sector as one of the main motors in demand driven development based on agricultural extension.

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