CHARACTERIZING ORGANISATIONAL LINKAGES IN THE AFRICAN INDIGENOUS VEGETABLE VALUE CHAINS IN KENYA

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ABSTRACT

African Indigenous Vegetables (AIVs) have the potential to contribute substantially to food and nutrition security in Kenya because of their high nutritious value for alleviating the wide spread hidden hunger. However there is a limited pool of knowledge on the AIV-innovations, this exploratory study introduces a graph-theoretic method for assessing linkages between organisations along the AIV value chains with an aim of identifying pathways of interactions between organisations. Information sharing, knowledge and resource flows were used as proxies to connote linkage. Empirical results show that the linkages between the organisations do exist, the pathway in the AIV value chain was found to be top-down approach, the organsations giving grants set the agenda with the research organisations after which information, knowledge and resource flows were passed to the marketing and extension service organisation. Then next can the processing and policy organisation and finally to the producer organisations. In this system, the producer organisation did not demand for information, knowledge and resources and thus the agenda was set for them, implying that there limited information sharing, knowledge and resource flows along the ALV value chain organisations. The role of policy is creating an enabling environment - in this study interpreted as access to information, knowledge and resources - is critical in ensuring that the organisation along the value chain have access to the information and resources needed to promote the production and utilisation of these vegetables. The envisioned optimal pathway then would be one that provides for a feedback mechanism and may not follow a linear one-sided module. Strengthening and empowering producers, extension service and marketing organisations is critical for the uptake and adaptation of inclusive innovations and technologies along the AIV value chains.

***Keywords**: African Indigenous Vegetables, Organisational linkages, Graph theory, Value chain, information and knowledge exchange*

INTRODUCTION

Background

Kenya's Vision 2030 aims at moving the country to middle-income status by 2030, offering all its citizens a high quality of life (GoK, 2010) The Medium Term Plan II (MTP II) 2013-2017 (GoK 2013) aims at accelerating economic growth, by placing the country on a higher, inclusive and sustainable growth trajectory leading to double-digit growth rate. In both, the Vision and the Second Medium Term Plan the strategic aims for the agricultural sector are to make it innovative, commercially-oriented, competitive and modern. Some of the priority areas of focus under MTP II are to enhance food security programmes, accelerate institutional reform, fast-track Vision 2030 flagship projects, reduce poverty and gender and regional inequality, and create employment. These will be achieved through several strategies including increasing productivity, promoting private sector participation in all aspects of agricultural development, and reforming agricultural services, regulatory, processing and manufacturing institutions for efficiency and effectiveness (GoK, 2010; GoK 2013).

For the government to achieve its Vision 2030 goals, the policy focus of the agricultural sector should reflect and support the MTP II objectives. And to support these objectives the Ministry of Agriculture Livestock and Fisheries have prepared a number of policy documents one of which is a draft on emerging crops (GoK, not published), this includes the African indigenous Vegetables (AIVs). The policy recognises that the potential of these plants is under-exploited in reference to their importance in food and nutrition security, health, income generation and environmental service. The policy highlights the following challenges that have contributed to the underdevelopment of this sub-sector; poor dissemination of technologies, lack or poor information and extension packages on the management of these crops along the value chain, and the research efforts on emerging crops are not coordinated or systematic.

The African Indigenous Vegetable

African indigenous vegetables (AIVs) including Spiderplant (Cleome gynandra), African nightshades (Solanum villosum and Solanum scabrum), Amaranths (Amaranthus spp.) Jute mallow (Corchorus olitorius), Crotalaria (Crotalaria ochroleuca and Crotalaria brevidens) and African eggplant (S. aethiopicum), just to mention but a few. AIVs are rich in micronutrients such as iron, zinc, Vitamin A, and contain non-nutrient substances called phytochemicals (Onim, et.al 2008; Abukutsa, 2010). There is a limited a pool of knowledge on the biological innovations (new seed varieties), chemical innovations (fertilizers and pesticides), agronomic innovations (new management practices), biotechnological innovations, and informational innovations for the AIVs. This is attributed to the low sensory appeal of these vegetables, loss of indigenous technical knowledge (ITK), ignorance on the nutritional and health benefits associated consumption of AIVs, limited supply of the vegetables, seasonality of production, limited post-harvest processing and seed shortage.

The production and marketing of AIVs are not a characterized by properly coordinated marketing structure. The degree of cooperation between actors of the vegetable chains is low. Actors prefer to operate individually and rely on self-help groups and not on contractual business relations. Co-operation is based on family or friendship relations (Van der Lans, *et*

al. 2012; Koenig, *et al.* 2008). There is no evidence of application of standards, rules and regulation to govern the sub-sector in terms of quality assurance. Thus, the objective of this study is to identify pathways of interactions between organisations in African indigenous Vegetable value chain and propose optimal pathways strategies/options available to value chain actors in influencing policy making.

One cannot over-emphasize the importance of evidence-based policy making. Evidence shows that, on the contrary, policy is rarely informed by research (Newman *et al*. 2013; Datta *et al.* 2011; Walter *et al.* 2005), that personal interest, 'political manipulation' and ambition come across as among the strong determinants of factors influencing policy pronouncements and processes thus development. However, where evidence from research exists, external actors (including civil society) and the public can play a pivotal role in influencing the policy process and development. The Kenya Constitution (2010) provides for a rights-based approach to development and it is, therefore, the prerogative and opportunity for the research community to disseminate its innovations and findings so that they can be used by policy decision makers.

The literature on research –practise –policy has drawn examples from education and the public health (Cooper, *et al*. 2009; Davies, *et al.* 2000; Lemieux-Charles, *et al.* 2004; Nutley, *et al.* 2007). There is no evidence of examples from horticulture. This study proposes to contribute to this discourse by providing evidence using the African leafy vegetable value chain, on how putting research into practice can inform policy, by examining how organisation along the value chain network with each other.

Conceptual framework

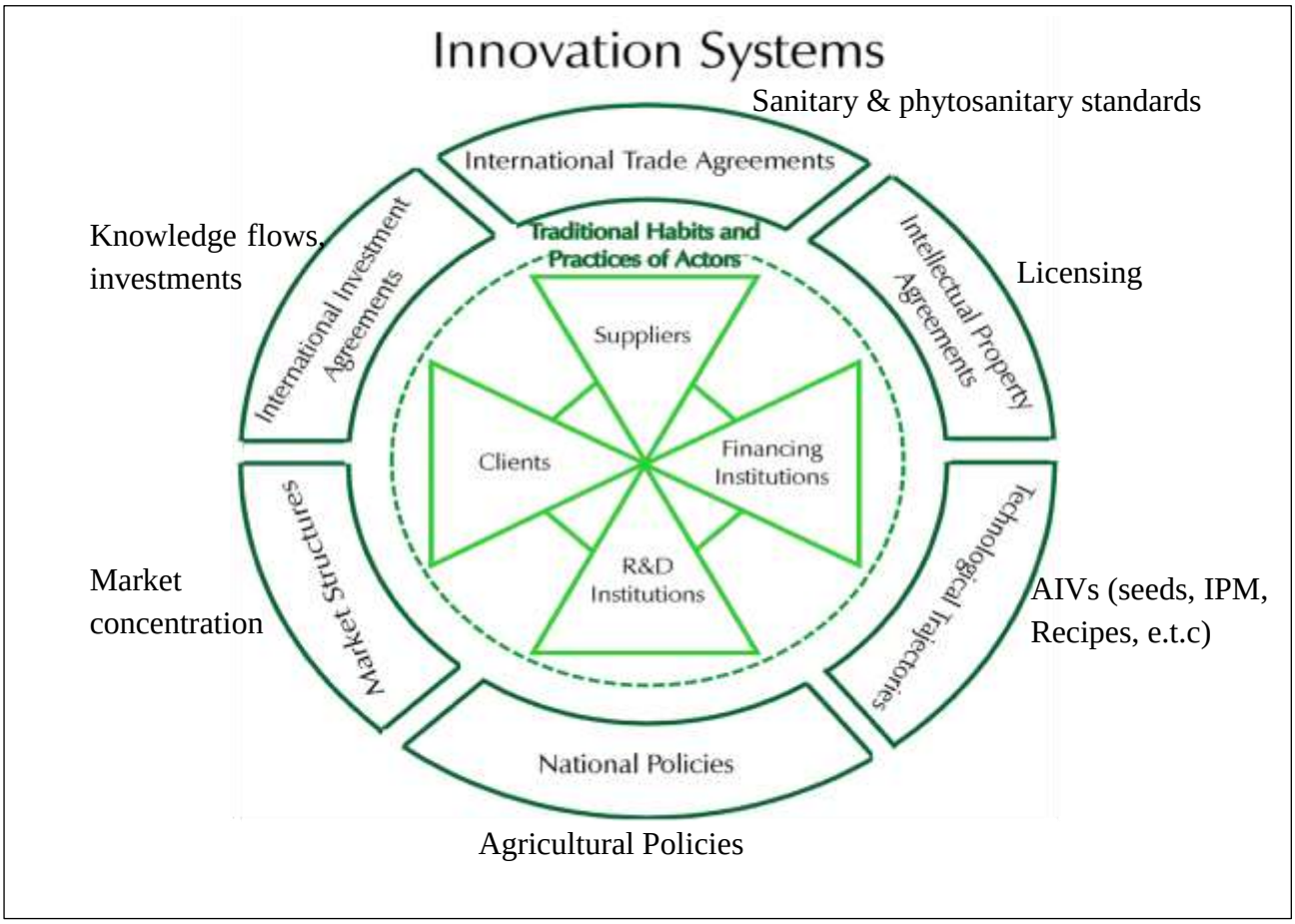
This section gives a brief overview of the agriculture innovation, which is a framework developed from the innovation system theory to try and identify and characterise linkages among the AIVs value chain organisation.

Agriculture innovation is defined broadly as technology, practice or product handling that will bring increased yield and income to the farmer. This can be done through modern production techniques used to improve production, quality, and quantity (World Bank, 2006). "Agricultural innovation is the process whereby individuals or organizations bring existing or new products, processes and forms of organization into social and economic use to increase effectiveness, competitiveness, resilience to shocks and/or environmental sustainability, thereby contributing to achieve food and nutrition security, economic development and sustainable natural resource management" (World Bank, 2012; FAO, 2012; FAO, 2014).

It is evident that agricultural innovation is an encompassing concept that accounts for different actors within a value chain, which nurtures interaction and learning. There are different ways to stimulate innovation, the process has moved from a more linear process where for instance science was the source of the invention or innovation to a more systematic process that involves a multiple stakeholders who interact with research and generate the ideas (OECD, 2010; FAO, 2012; World Bank, 2006). For the innovation system to work communication is critical to support this process and the social impact can then be identified

through the interactive learning that leads to tangible outputs. Agricultural innovations can be classified broadly in the following categories (i) mechanical innovations (tractors and combines), (ii) biological innovations (new seed varieties), (iii) chemical innovations (fertilizers and pesticides), (iv) agronomic innovations (new management practices), (v) biotechnological innovations, and (vi) informational innovations (FAO, 2012; World Bank, 2012; OECD, 2011; World Bank, 2006)

The agricultural innovation system concept has evolved over time from approaches such the transfer of technology approach (Jarrett 1985) of the 1960s where the focus was productivity driven by technology-based packages generated by research. Science and Technology worked independently of other actors along the value chain. The era starting from the 1970s through to the 1980s saw with it a number of approaches namely; induced innovation (Ruttan, *et al*. 1984) , training and visit system (Hulme, 1992) , participatory research and participatory technology development (Farrington, *et al*. 1988; Neef *et al.* 2011) , farmer first (Chambers *et al*. 1989) here the focus moved towards multi-disciplinary initiatives, farmer needs and constraints were taken into account, there was emphasis on efficiency gains and packages prepared to maximize on those. The 1990s saw the agricultural knowledge, and information systems (AKIS) (Röling, 2009) approach the emphasis was on collaborative, participatory, inter- disciplinary research base on demand from end users. Social, political, economic issues were embedded in this approach. From the year 2000 and beyond the agricultural innovation systems approach gained momentum. This system in addition to the attributes of the AKIS encompasses value chains; institutional change shared learning trans-disciplinary, holistic system perspectives which facilitate co-development of innovation involving multiple actors and partnerships (Sanginga, *et al*. 2009; Hall, *et al*. 2006; Vellema 2008; Pant, *et al.* 2009). The concept of agriculture innovation has widened over time and is shown in the diagram below Figure 1.



Adapted from (Mytelka, 2000)

Figure 1: A Schematic innovation system

Agriculture Innovation systems account for a large number of stakeholders who participate in the value chain and play different roles to ensure that the innovations are created, transfer and adopted. The Government in most cases provides strategic direction, implement policies and regulations, and an enabling environment for the value chain to thrive. Financial support is necessary to fund research and infrastructure (soft and hardware) in both in public and private organisations. Information and communication technologies (ICT) is critical for this system to work (Mytelka, 2000; FAO, 2012).

For the purposes of this paper, agricultural innovation systems will be examined in the context of the value chain and how the organisations shown in figure 1 above interact.

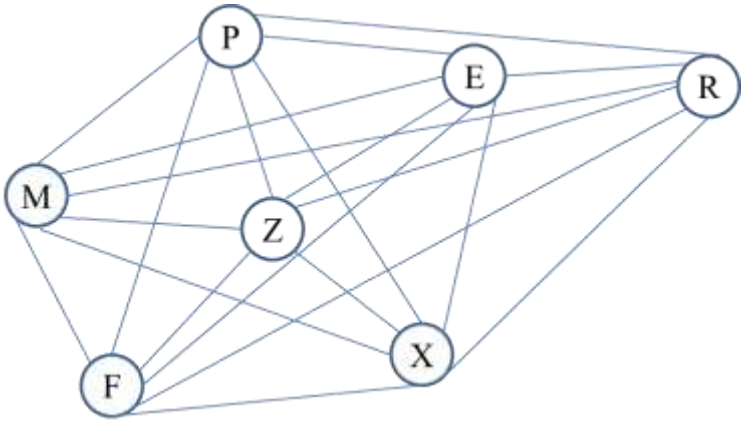
MATERIALS AND METHODS

The study attempts to explore social network analysis in the context of the ALV value chain, it borrows data from a study done on pro-poor innovations (Gevorgyan, *et al*. 2015), the graph theoretical method is used to expound on the organizational linkages along the AIV

value chain actors. The assumption is that value chain actors can be defined as part of a system. They constitute a set of agents or institutions formal or informally organized around a common goal.

The pre-determined goal of this value chain is food and nutrition security. Therefore, the aim of the system is to capture the interactions related to the pre-determined goal. The interactions in this system will be a measure of the dominant and subordinate components that influence the development of effective policies or programs, and ways to improve the effectiveness of the system (Castells, 2011 and Enroth, 2010). Real world systems can be simulated using generation network algorithms. Graph theory the nodes can be represented by the organizations and the links (edges) by the nature of interactions (Dunn *et al.* 2013; Albert *et al.* 1999). The theoretical context also provides a basis for measuring how elements of the organisational linkages can influence policy implementation.

Graph theory is used to develop a matrix that maps cross-category linkages along the value chain; the linkages will be measured by three elements namely; Information, Knowledge, and Resource (physical and monetary) flow. Figure 2 shows that the linkages between organisations are not necessarily linear and can take multiple paths.



Key: 7 categories: Producers(P), Research (R), Extension (E), Marketing (M), Processing (Z), Grants (F) and Policy (X).

Source: Authors conceptualization

Figure 2: Schematic representation of the organisational linkages

The key assumption is that cluster of actors under the categories are homogeneous in their quest for information, knowledge and resource (physical and monetary). In other words, the extent of within-category agents' heterogeneity and the structure and change in the relationships and networks among agents does not account for in this analysis. For the purposes of this paper, a square matrix is used to explain the linkages and account for pathways used to share information, knowledge, and resource (physical and monetary).

ALV value chain =

P	PR	PE	PM	PZ	PF	PX
RP	**R**	RE	RM	RZ	RF	RX
EP	ER	**E**	EM	EZ	EF	EX
MP	MR	ME	**M**	MZ	MF	MX
ZP	ZR	ZE	ZM	**Z**	ZF	ZX
FP	FR	FE	FM	FZ	**F**	FX
XP	XR	XE	XM	XZ	XF	**X**

Source: Authors conceptualization
Key: 7 categories: Producers(P), Research (R), Extension (E), Marketing (M), Processing (Z), Grants (F) and Policy (X).

To assess the strength of the institutional linkages, data on responses by organizations regarding their opinions on the degree of influence each organization has to other organizations is used. The degree of influence is scaled using the crisp scores where there was more than one response, the average of the scores was taken. The cause and effect structure is represented by the summation of the rows and columns respectively.

DATA

Data used in this study is based on a field study carried out in *Kiambu* (peri-urban) and *Kakamega* (rural) Counties in Kenya in September – October 2014 (Gevorgyan, *et al*. 2015). The study team conducted 28 individual interviews with experts and key stakeholders in order to assess the actor's roles in and perceptions of the ALV innovation ecology and to analyse their interactions and linkages with others. Seven (7) farmer groups were interviewed in *Kakamega* County and 4 farmers groups in *Kiambu* counties. Two focus group discussions were conducted one with extension officers and the other nutritionists from the public health department to understand their role as the link between the value chain and other actors.

Category	Number of Respondents
Producers(P)	11 farmer groups
Research (R)	11
Extension (E)	5 (3 Private + 2 Public)
Marketing (M)	6
Processing (Z)	2
Grant (F)	1
Policy (X)	3

Data was collected using a semi-structured questionnaire, and the responses were grouped into value chain organizations with respect to information, knowledge, and resource (physical and monetary) flows and after which, were converted into crisp scores. Based on fuzzy set theory (Zimmermann, 1991) a five-point fuzzy scale is used for evaluating the relative importance (Chen and Hwang, 1992) was used to convert fuzzy numbers into crisp scores. Crisp Scores: Strong =1, above average =0.75, Average =0.5, Weak =0.25, Non-existent =0. The crisp scores for a fuzzy number were obtained as follows:
Given maximizing and minimizing sets such as:

$$\mu_{max}(x) = \begin{cases} x & 0 \leq x \leq 1 \\ 0 & otherwise \end{cases}, \qquad \mu_{min}(x) = \begin{cases} 1, & -x\ 0 \leq x \leq 1 \\ 0, & otherwise \end{cases}$$

RESULTS AND DISCUSSIONS

Strength of linkages between Organisations

Seven categories cross organisational linkages were mapped based on information, knowledge and resource flows and the extent and direction of influence. That is the first row of the matrix above shows the mechanisms and ways by which the producers, for instance, claimed to influence the rest of the organisations along the value chain. The second row likewise shows how research organization influenced the rest of the organization along the value chain and the same applies to the other rows and columns. Table 1 below shows that producers have strong linkages with research and grant providing organisations, this is attributed in part to the fact that most of the farmer groups interviewed were part of / or were formed as a result of a research project initiative. Gevorgyan *et al.* (2015) highlights a few examples where producers were given planting materials at a subsidized cost or absolutely free, in other instances, research organisations involved producers in their experimental work in return for information and data. County governments are also involved in providing free planting materials to the producers. Concerning the organisations giving grants an example is given of an initiative that provides common interest groups with grants of up to 3 million Kenyan Shillings per year to facilitate services such as extension, soil analysis and/or advice on marketing. This is in addition to other products available from commercial banks and Savings and Credit Cooperative Organisations (SACCOs).

Strength of linkages between Organisations matrix

ALV value chain =

P	1	0.75	0.75	0	1	0
1	**R**	1	1	0.5	1	1
0.75	0.75	**E**	1	0.75	1	0.5
0.75	0.5	1	**M**	1	0.5	1
0	0.5	1	0.5	**Z**	1	1
1	1	1	1	1	**F**	0.75
0	1	0.5	1	1	0.5	**X**

Key: Strong =1, Above average =0.75, Average =0.5, Weak =0.25, Non-existent =0.

Table 1: Strength of linkages between Organisations

	Producers	Research	Extension services	Marketing	Processing	Grants	Policy
Producers	**P**						
Research	Strong	**R**					
Extension services	Above Average	Above Average	**E**				
Marketing	Above Average	Moderate	Strong	**M**			
Processing	Non-existent	Moderate	Strong	Moderate	**Z**		
Grants	Strong	Strong	Strong	Strong	Strong	**F**	
Policy	Non-existent	Strong	Moderate	Strong	Strong	Moderate	**X**

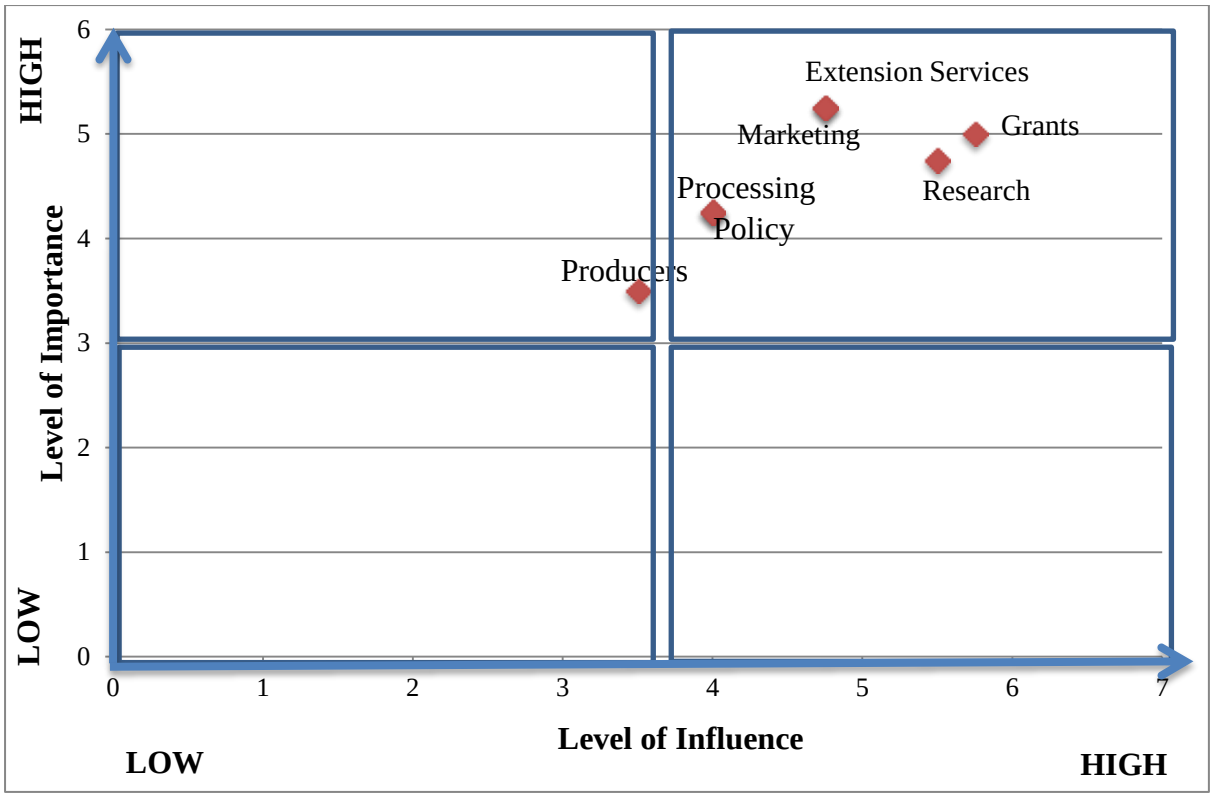
Key: *Strong =1, Above average =0.75, Average =0.5, Weak =0.25, Non-existent =0.*
Source: Authors' computations

Policy, research, marketing, and processing organisations had strong linkages; this was explained by their regulatory relationship. These organisations by law have to fulfill certain requirements for instance before a product is allowed to trade it has to be tested and meet a certain threshold this is done by the research organizations, in addition, the product will have to be licensed as safe for human or animal consumption. The licensing is carried out under certain policy regulations. Policy organisation recorded a none -existent linkage with producers implying that there was no perceived mutual benefit from this linkage i.e. neither of the parties appreciated their existence. This notion is to some extent true for both extension and organizations providing grants who recorded a moderate linkage. This is because policy in this context was interpreted to have a more regulatory role than a facilitating role i.e. creating an enabling environment.

Importance and Influence

The importance and influence decision was constructed by computing a cause and effect structure. The effect is defined as the influence of each of the rest of the components on that single component. The cause is defined as the influence of a single component (e.g. policy or research) on each of the rest of the components, which is represented by the summation of the rows. For instance, for research, the cause is the influence that the organisations in research have on all other organisations while the effect is the influence that all other organisations have on the organisations under research.

Figure 3 below, show that all the organisations except the producers have high importance and high influence, implying that in this value chain these organisations can make a difference, this aspect is explained partial by the sampling frame.



Source: Authors' computations

Figure 3: The Importance and Influence structure of the AIVs Value chain organisations

Producers have the lowest influence in this value chain organisation imply that in this chain they are considered as a consumers of information, knowledge or resource that are generated by other actor organisations along the value chain. Policy and processing, on the other hand, are high in importance and have medium level of influence, in other words their influence is obvious however cannot be ignored. Extension service and marketing organisations are important and have an influence on other value chain organisations. This cannot be overemphasised as they are the key organisations that ensure quality and quantity of produce and availability of the produce to the consumers. The information, knowledge and resource flow sources can, therefore, be deduced to be organisation giving grants and research organisations while the sink is the producer organisations.

CONCLUSION

Based on the results shown above it is evident that there is a exisits linkages between the value chain organisations. The all organisation along the value chain expect the producers report high importance and influence. In this chain the pathway for information, knowledge and resource flows was initiated by the organization providing the grants financial service *to* the research organisations who then involved the marketing and extension service

organisations *to the* processing and policy organisation and finally *to* the producer organisations. This system portrays a top-down approach, unlike where the producer organization demand for information, knowledge and resources and thus set the agenda. Clearly, can be inferred to indicate that the policy agenda set out by the government in the emerging crops document was not based on evidence as far as the AIVs value chain is concerned.

The pre-determined goal of this value chain is food and nutrition security in order to achieve this goal the productivity and competitiveness of the value chain need to be enhanced. The role of policy in creating an enabling environment in this study interpreted as, access to information, knowledge and resources will be critical in promoting the production and utilization of these vegetables. The envisioned optimal pathway would be one that provides for feedback mechanisms, such that producer organisation can demand for innovations and evidence is generated by the research organisations. This evidence is then used along the value chain by the different actor organisation, including policy which provides an enabling environment for the different organisations along the value chain to thrive. It is important to note that the pathway will have to provide a feedback mechanism and may not follow a linear module. Strengthening and empowering producers, extension service, and marketing organisations is critical for uptake and adaptation of inclusive innovations and technologies along the AIV value chains.

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