

Full Length Research Paper

Innovations in the soyabean innovation system in Benue State, Nigeria

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The study determined the factors hindering innovation in the soyabean innovation system in Benue State, Nigeria. A total of 100 respondents were selected using simple random sampling technique. Data were analyzed by use of frequency, percentage and mean statistic. The result of the study indicated that a number of innovations were introduced and classified into produce/process innovations, the basic research innovation and the marketing/managing strategy innovations. The study also revealed that among the product/processing innovation introduced in the soyabean innovation system, soya milk ($x = 2.78$) was the most preferred innovation, while the least preferred innovation was Soya garri ($x = 1.55$). The study also revealed that ten factors were identified as major factors hindering innovation in the soyabean innovation system. These were lack of new knowledge ($x = 2.32$), lack of research policy ($x = 2.26$), lack of capital ($x = 2.78$), lack of markets ($x = 2.34$), lack of competent human capital ($x = 2.11$), lack of research and extension ($x = 2.26$), lack of patency ($x = 2.12$), lack of regulation in the innovation system ($x = 2.32$), lack of functional processing industrial system ($x = 2.74$), lack of stakeholder interaction ($x = 2.19$). It was recommended that the introduced innovation should be nurtured and patented by regulatory bodies while the preferred products innovation given high acceptability rating be guaranteed funding by commercial banks and such finance institutions to commercialize these products to stimulate further innovations. Finally, the factors isolated as hindering innovation in the soyabean innovation should be ameliorated through policy options and conscious intervention measures.

Key words: Innovation system, factors, critical actors, soyabean.

INTRODUCTION

Benue State is the largest producer of soyabean (*Glycine max*) in Nigeria (BNARDA, 2000). In 1985 Benue State was declared a special soyabean producing area by the Federal Government in order to concentrate efforts where comparative advantage is greatest in line with its ecological specialization policy. The importance of soyabean as a high protein, primary input in vegetable oil, dairy and feed industries is not in doubt. The International Institute for Tropical Agriculture (IITA) has enhanced its protein content to 40% level. This makes

the crop a suitable substitute to animal protein (Ayoola, 2001).

In agriculture an innovation can be a practical technique or different way of doing things like when a farmer makes a new arrangement about how land should be used with a neighbor. Basically, innovation is universal and occurs in every environment depending on the complexity and commercial value. The basic rule is that it usually arises as a result of interaction (LEISA, 2000). Three broad categories of innovation in the Nigeria

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agriculture innovation systems are (a) innovation in product technology (b) innovation in genetic engineering and bio-control and (c) innovation in process technology (Ayoola, 2001). With respect to product innovation, following the Structural Adjustment Programme there was lack of foreign exchange to import animal protein. To alleviate the problem soyabean utilization programmes were mounted and many recipes were prepared to reduce malnutrition among the low income people. The products locally produced include soymilk, soybread, soygarri, soysnacks (cakes), soy-cooking oil, fried soyabean flour (Ayoola, 2001; Agbulu and Wombo, 2005; Lawal et al., 2005). According to Lawal et al. (2005), soyabean milk has the highest acceptability while soyabean cake was least used.

With respect to soyabean innovation system, aside from the product innovation the genetic engineering innovation needs to be highlighted. In the genetic innovation category the production of soyabean is based on traditional farming system using varieties such as the pod shattering Malaysian varieties. This was introduced by the early Christian missionaries. Current improved varieties include those produced by IITA (TGX and TGM varieties) and Institute of Agricultural Research (IAR), Ahmadu Bello University, Zaria (Sams soy varieties). Improvement in yield rose from mere 200 kg per ha to above 1.5 tons per ha (Ayoola, 2001). About 70 improved varieties of soyabean have been developed for use in the Nigerian farming system (Conroy, 2003). The dominant varieties disseminated by the Benue State extension system are: Early/Median Maturing (100 to 120 days): Sam-soy 2 (M216), Sams soy 1 (M79); TGX 536 – 026, TGX 539 – 5E, TGX 923 - 2E, TGX 292 – 172C, M98 and M351, TGM 579. The late maturing (> 120 days) TGX 306 – 036C, TGX 725 – 011D, TGM 244 (BNARDA, 2000).

The promotion of joint private enterprises and joint venture investment involving government to increase the value added utility of soyabean resulted in the establishment of the Taraku Mill. The Taraku soyabean mill has the Capacity to process 72,000 metric tons of soyabean into about 10,000 metric tons of refined soyabean oil, 61,000 tonnes of soyameal and 900 metric tonnes of soap per annum (Ayoola, 2001). However the mill, producer of “Golden Soya” cooking oil, operates at 30% installed capacity despite the fact that it is located in Benue State where soyabean production is concentrated. According to Ayoola (2001) various strategies have been implemented to accelerate the production of soyabean in Nigeria. These include technology inducement, awareness campaign, promotion of ecological specialization and traditional support services such as extension and input services.

Special significance to the innovation system is the interactive activities of stakeholders in the soyabean industry. The National Soyabean Association (NSA) provides a forum for interaction of individuals, enterprises

and agencies involved in the soyabean industry. At the forum, research scientists derive their research priorities and problems directly from farmers, ADPS, processors, marketers, and consumers. To enhance academic interaction newsletters, proceedings of conferences/meetings and the Tropical Oil Seed Journal are published, and these support interaction with international community on soyabean matters. These activities enhanced net working among actors in the soyabean industry (Ayoola, 2001).

Despite these initiatives soyabean innovation system in Benue State has not recorded any marked adequacy of quantum of soyabean innovations and partnership. The soyabean mill at Taraku produces below capacity. Furthermore, importation of soyabean, the primary raw materials is done from Brazil and neighbouring West African countries unabated (Abagu, 2004). Ayoola (2001) suggested the following measures to mitigate this situation: (1) institutional integration where the relevant agencies and corporate bodies come together in the process of generating commercial research findings and technological breakthrough and (2) monitor the appropriateness of the existing and newly emerging innovations.

The (Technical Centre for Agricultural and Rural Cooperation /United Nations University-Institute for New Technologies/Koninklijk Instituut Voor de tropens, CTA/UNU – UNITECH/KIT, 2005) noted that national markets in the developing world are highly fragmented and national research and development institutions are poorly linked to the production centres. As a result centers do not sufficiently and adequately supply science, technology and innovation to facilitate meeting the challenges of competing effectively in the global market. Consequently, strengthening innovation system is extremely important to improve the interface between scientists, the dissemination and utilization subsystem, policy makers and decision makers as relate to science, technology and innovation policy formulation. This calls for a study of the innovation system of soyabean in Benue State in order to suggest policy options on the types of innovation introduced in the soyabean innovation system the preference level of innovation introduced and the factors that inhibit innovation among the critical actors in the soyabean innovation system.

Purpose and objective

The overall purpose of the study was to assess the soyabean innovation system in Benue State. The specific objectives of the study were to; (i) identify the innovations introduced in the soyabean innovation system; (ii) determine the preference level of the innovations introduced in the soyabean innovation system, and (iii) determine the factors that hinder innovation among the critical actors in the soyabean innovation system.

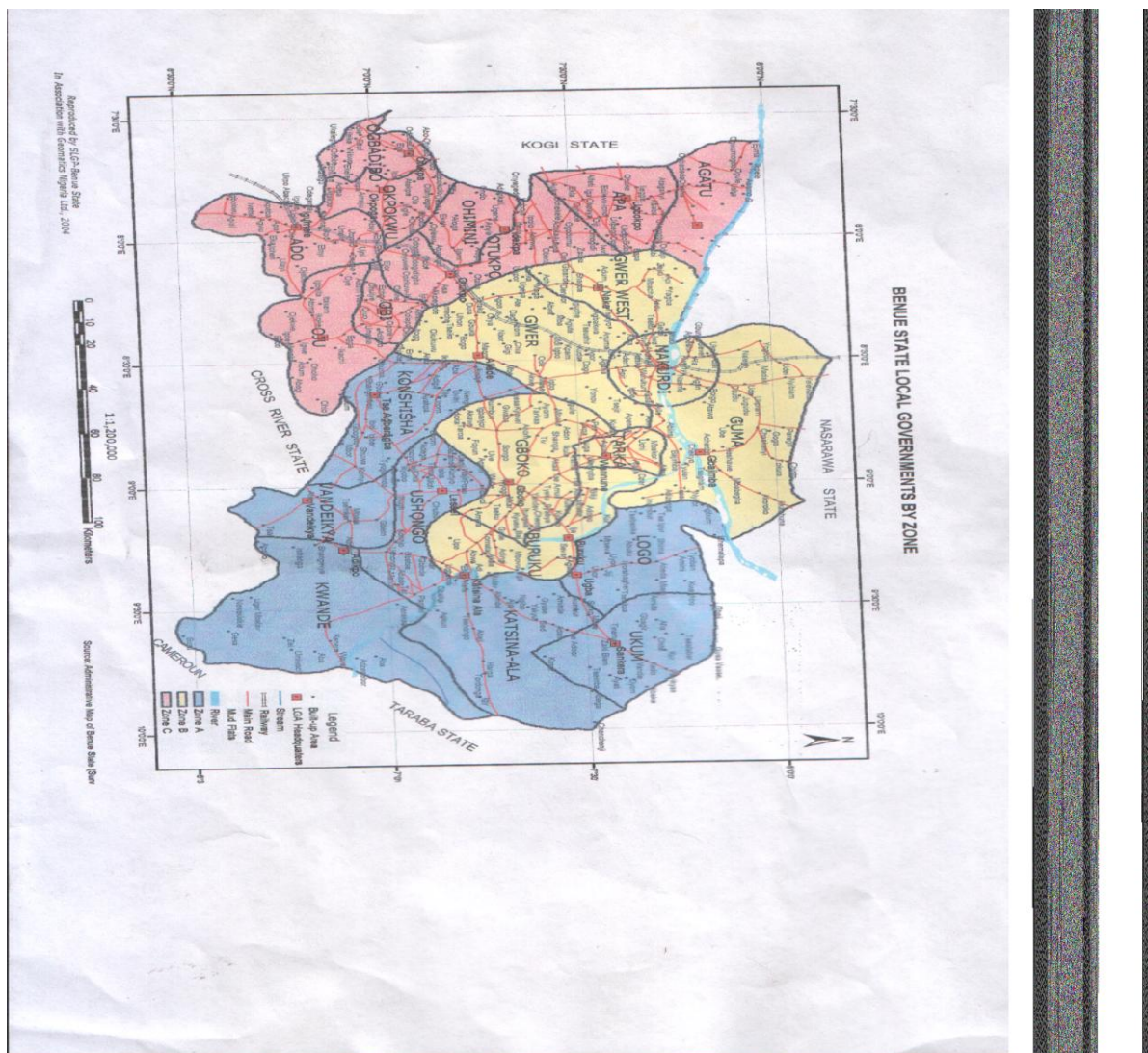


Figure 1. Map of each State.

METHODOLOGY

Benue State derives its name from River Benue, the second largest River in Nigeria. The State is located in the central agro-ecological region of Nigeria. According to the 2006 census the population of the State is 4,219,244 (NPC, 2006). It occupies a total land mass of 3,0855 square kilometres (Benue State Government, 2002). Majority of the people are subsistent arable farmers while the riverine inhabitants engage in fishing as their primary occupation. Benue State is the largest producer of soyabean, beniseed, cassava and yam in Nigeria (Benue State Government, 2002). Subsistence and rainfed traditional farm practices are the dominant mode of farming. Benue State is comprised of 23 administrative local government areas. The state is divided into three agricultural zones. Northern zone comprising of 7 LGAs with Gboko as headquarters. Eastern Zone has 7 LGAs with headquarters at Adikpo while the Central zone is made up of 9 LGAs with headquarters at Otuokpo. The Northern and Eastern zones are inhabited by Tiv, while the central zone is inhabited by Idoma and Igede. Soyabean is mainly produced in the Northern and Eastern Zones (BNARDA, 2000).

The population of this study was stakeholders (Critical actors) in the soyabean industry. Specifically it consisted of sample drawn from two local government areas from each of the northern and eastern agricultural zones of Benue State where soyabean is mostly produced (Figure 1).

Selection of samples in each of the LGAs was based on the segmentation of actors in the soyabean innovation system into components. According to Paterson et al. (2003) and CTA/UNU-INTECH/KIT (2005) the component of the agricultural science technology innovation (ASTI) system can be classified into five namely: Demand enterprise, diffusion research and infrastructure.

- (i) Demand component: Actors includes consumers of food and food producers in rural and urban areas; consumers of industrial raw materials, international commodity market,
- (ii) Enterprise components: Farmers; input suppliers (seeds, agro-chemicals, animal feed), service suppliers (advice, credit, insurance, machinery rentals etc); commodity traders, transporters; agricultural processing industries; farmer and trade organization representing business interest,
- (iii) Diffusion components: Extension service (public/private), non

governmental organizations (NGOS) and community based organizations (CBOs), farmer and trade organizations, input and service suppliers,

(iv) Research component: National and international agricultural research organizations; universities and other institution of higher learning, private research foundations; private companies and NGOs with own research facilities,

(v) Infrastructure component: Policy making process and agencies; banking and financial system, transport and marketing system, information and communication infrastructure; professional networks, including farmer and trade organizations, regulatory agencies (Sanitary and phyto-sanitary regulations etc), standard setting bodies.

Five respondents who were identified as critical actors in the soybean innovation system were selected by purposive sampling methods from each of the 5 components from each of the four sampled LGAs: Gboko, Gwer, Katsina-Ala and Makurdi. The four LGAs were selected by simple random sampling method, a total of 100 respondents were selected through purposive and random sampling method for the study.

Instrument for data collection

Data were collected through the use of interview schedule and questionnaire. Both instruments were validated to reflect all the objective of the study. These were administered to respondents in each LGA.

Measurement of variables

Objective 1 was achieved by listing the innovation introduced; objective 2: The preference level of innovations were measured by asking the respondents to indicate the perceived preference level of each of the listed innovations on a 3-point Likert type scale ranging from highly preferred = 3, moderately preferred = 2 and not preferred = 1. These values were added to get a value of 6 which was later divided by 3 to get a mean score of 2.0. The respondents mean was obtained on each of the items. Any mean (X) score ≥ 2.0 was regarded as preferred while any mean (X) score less than 2.0 were regarded as not preferred. Objective 3: The factors hindering innovation were measured by asking the respondents to indicate their perceived level of importance of each of the listed factors on a 3-point Likert type scale ranging from very important = 3; important = 2 and not important = 1. These values were added to get a value of 6 which was later divided by 3 to get a mean score of 2.0. The respondents mean was obtained on each of the items. Again, any mean (X) score ≥ 2.0 was regarded as important; while any mean (X) score less than 2.0 was regarded as not important. Specifically objective 1 was analyzed by use of frequency and percentage, objectives 2 and 3 were analyzed by use of mean statistic.

RESULTS AND DISCUSSION

Innovations introduced in the soybean innovation system

Data in Table 1 indicate efforts of the soybean innovation system in Benue State in introducing innovations. The results show that 24 innovations have been introduced in the soybean innovation system in Benue State. The two most mentioned innovations in each

categories were soyabean milk (70%), soyabean oil (64%); in the product/processing innovation category, successful trial of improved high yielding, disease resistant, non pod shattering hybrid seeds (TGX - 1448-2E) (11%); appropriate fertilizer type and rate recommendation (9%) were innovations introduced in the basic research innovation category; while compulsory soyabean producers cooperative meeting (10%), appropriate marketing strategies by by-passing middle men to enable soyabean farmers earn more income (10%) were innovations introduced in the marketing/management strategy innovation category. The overwhelming preference for soyabean milk and soyabean oil is probably because soyabean milk and soyabean oil are traditionally used as compliment to breast milk and cooking oil for adults respectively. This implies that many innovations have been introduced and that adoption of these innovations will enhance the performance of the soyabean innovation system.

Preference of product/processing innovations in the soyabean innovation system

Results of performance of products/processing innovations in the soybeans innovation systems are presented in Table 2. Respondents in the demand components preferred soymilk ($x = 2.80$) and soy cooking oil ($x = 2.80$), this was followed by soy bread ($x = 2.15$) and fried soyabean flour ($x = 2.15$). This is probably because these products serve as small businesses in the innovation system. Similarly, respondents in the enterprise component preferred soy cooking oil ($x = 3.40$), soymilk ($x = 2.60$), fried soyabean flour ($x = 2.40$) and soy bread ($x = 2.10$). The higher preference for soy cooking oil than soya milk by respondents in the enterprise components is probably because soy cooking oil has a longer shelf value than soya milk which is perishable. Thus soy cooking oil can be kept and sold gradually.

The respondents in the diffusion component preferred only soymilk ($x = 2.5$), soy cooking oil ($x = 2.75$) and fried soyabean flour ($x = 2.05$). This is probably because these products serve as source of protein and small businesses in the innovation system. The commercialization of these innovations will boost commercial activities and enhance the soyabean innovation system. Respondents in research component showed prepared to soymilk ($x = 2.90$), soy cooking oil ($x = 2.90$), fried soyabean flour ($x = 2.25$) and soybread ($x = 2.05$). These products are useful sources of business. The higher preference of soy milk by the research component is probably because the product is commonly utilized by researchers to provide nutrients as a replacement to animal protein and has been promoted by the UNICEF to replace or compliment breast milk in Benue State recently.

Respondents in the infrastructure components preferred soy cooking oil ($X = 2.75$) soy milk ($x = 2.70$),

Table 1. Distribution of respondents by innovation introduced in the soyabean innovation system in Benue State. (n=100).

S/N	Product/processing innovation	F	%	Basic research innovation F	%	Marketing/management innovation F	strategy	%
1	Soyabean milk 70	70.00		(1) Successful trial of 11 improved high yielding, disease resistant, non pod shattering hybrid seeds (Tgx – 14 48 –2E)	11.00	(1) Compulsory 20 soyabean producers cooperative meetings		20.00
2	Soyabean oil 64	64.00		(2) Appropriate fertilizer 9 type and rate recommendation for soyabean production	9.00	(2) Appropriate marketing strategy by bypassing 10 middlemen to enable soyabean farmers earn more income		10.00
3	Fried soya 30 bean flour (<i>mumu</i>)	30.00		(3) Appropriate soyabean weeding regimes	6.00			
4	Soyabean 11 Akara/ cake	11.00		(4) Best storage methods	5.00			
5	Soyabean 11 Pomade	11.00		(5) Appropriate chemical weed control	5.00			
6	Soyabean 10 Garri	10.00		(6) Appropriate prototype threshing machines	5.00			
7	Soyabean 10 condiment (<i>nune</i>)	10.00		(7) Appropriate soyabean plant spacing (40 × 10 cm) and time of planting	5.00			
8	Soyabean 9 livestock feeds	9.00		(8) Appropriate threshing methods	5.00			
9	Soyabean 4 meal	4.00						
10	Soyabean 4 Soup	4.00						
11	Soyabean flour 4	4.00						
12	Soyabean Moimoi 2/budding	2.00						
13	Soyabean 2 Potash	2.00						

F = Frequency, * Multiple Responses, Source: Field Survey, 2006.

and fried soyabean flour ($x = 2.05$). The implication of this finding is that the patenting and commercialization of these innovations shall enhance the soyabean innovation system. The findings of this study show that the two most consistently preferred soyabean product innovations among respondents in the five components of the soyabean innovation system in Benue State were soymilk and soya cooking oil. This confirms the

findings of Lawal et al. (2005) that soyabean milk has the highest acceptability rating in Benue State. This implies that processing soya beans into *Akpukpa* and soy milk were most profitable in the Benue State soyabean innovation system. Therefore, the appropriate packaging and commercialization of these soyabean products may probably enhance the innovative performance of the soyabean innovation system in Benue state

(Table 2).

Factors that hinder innovation among critical actors in the soybean innovation system

The serious factors hindering innovation as perceived by actors in the demand component were: Lack of knowledge ($x=2.40$), lack of research

Table 2. Mean soyabean product preference.

S/N	Innovation	Mean (X) preference score of components					
		Demand	Enterprise	Diffusion	Research	Infrastructure	Mean (X)
1	Soymilk	2.80*	2.60*	2.8*	2.90*	2.70*	2.76*
2	Soybread	2.15*	2.10*	1.8	2.05*	1.95	2.01*
3	Soygarri	1.35	1.65	1.45	1.65	1.80	1.58
4	Soy cooking oil	2.80*	2.40*	2.75*	2.90*	2.75*	2.72*
5	Fried soyabean flour	2.15*	2.40*	2.05*	2.25*	2.05*	2.18*

*, Preferred product/processing innovation. Source: Field survey, 2006.

policy (x = 2.15), lack of capital (x = 2.70), lack of markets (x = 2.35), lack of competent human capital (x = 2.25), lack of research and extension (x = 2.15), lack of patency (x = 2.0), lack of regulation in the innovation system (x = 2.15), lack of functional processing industries (x = 2.86) and lack of adequate stakeholder interaction (x = 2.00) (Table 3). The lack of capital was the most serious problem hindering innovation among the critical actors. Lack of finance could deter actors from engaging in new areas to innovate. The implication of this finding is that the listed factors were probably responsible for the few innovations introduced in the soyabean innovation system in Benue State. Therefore, to enhance innovation among the critical actors in the soyabean innovation system in Benue State, the identified serious factors must be mitigated.

According to the respondents in the Enterprise component (Table 3) indicated that the serious factors hindering innovation in the soyabean innovation system in Benue State were: lack of new knowledge (x = 2.35), lack of research policy (x = 2.50), lack of capital (x = 2.55), lack of markets (x = 2.05), lack of competent human capital (x = 2.05), lack of research and extension (x = 2.30), lack of networking (x = 2.15), lack of patency (x = 2.30), lack of regulation in the innovation system (x = 2.40), and lack of functional processing industries (x = 2.65). Lack of finance was again identified as the serious hindering factor to innovation. This is probably because commercial banks tend to give loans based on collateral which the small scale innovators cannot guarantee. Therefore policy option to make credit facility available to small scale processors should be considered by stakeholders interested in promoting innovations in the soyabean innovation system in Benue State.

The factors hindering innovation as perceived by actors in the diffusion component were: lack of research policy (x = 2.15), lack of capital (x = 3.10), lack of markets (x = 2.40), lack of research and extension (x = 2.00), lack of regulation in the innovation system (x = 2.10), lack of functional processing industries (x = 2.65), lack of adequate stakeholder interaction (x = 2.10).

The factors in this study may have been responsible for the low performance of the soyabean innovation in Benue State. The improved innovative performance of the system

policy options must be put in place to alleviate the identified factors hindering innovations as identified by actors in the diffusion component. The factors identified by actors in the research component were: lack of new knowledge (x = 2.70), lack of research policy (x = 2.45), lack of capital (x = 3.10), lack of markets (x = 2.40), lack of competent human capital (x = 2.15), lack of research and extension (x = 2.60), lack of patency (x = 2.35), lack of regulation in the innovation system (x = 2.55), lack of functional processing industries (x = 2.90) and lack of adequate stakeholder interaction (x = 2.55). These factors are probably responsible for the few innovations introduced in the soyabean innovation system. Policy options should therefore be put in place to mitigate the factors hindering innovation for effective performance of the innovation system.

Respondents in the infrastructure component identified the following factors as responsible for hindering innovation in the soyabean innovation system in Benue State: lack of new knowledge (x = 2.25), lack of research policy (x = 2.45), lack of capital (x = 2.75), lack of markets (x = 2.53), lack of competent human capital (x = 2.25), lack of net working (x = 2.00), lack of regulation in the innovation system (x = 2.40), lack of functional processing industries (x = 2.70), and lack of adequate stakeholder interaction (x = 2.00). These factors were probably responsible for the low interaction among actors in the infrastructure component of soyabean innovation in Benue State. To improve the innovative performance of the infrastructure component and hence the soyabean innovation systems policy options to ameliorate these hindering factors must be given adequate consideration.

The factors identified in each component were probably responsible for the low total interaction score (TIS) by the five components and hence few innovations introduced in the innovation system. The factors hindering the soyabean innovation system in Benue State are similar to those identified by John and Jacobsson (2002) in their studies on innovation in the German, Dutch and Swedish wind turbine industries. It is probable that factors that hinder innovation in industries are similar to those that hinder innovation in agricultural innovation systems. Policy options should be considered by policy makers and implementers to alleviate these serious factors in

Table 3. Mean factors hindering innovation among critical actors in the soyabean innovation system in Benue State. (n=100).

S/N	Factor	Mean (X) score of components					
		Demand	Enterprise	Diffusion	Research	Infrastructure	Mean (X)
1	Lack of new knowledge	2.40*	2.35*	1.90	2.70*	2.25*	2.32*
2	Lack of research policy	2.15*	2.50*	2.05*	2.15*	2.45*	2.26*
3	Lack of capital	2.70*	2.55*	2.80*	3.10*	2.75*	2.78*
4	Lack of markets	2.35*	2.05*	2.40*	2.40*	2.53*	2.34*
5	Lack of competent human capital	2.25*	2.05*	1.85	2.15*	2.25*	2.11*
6	Lack of research and extension	2.15*	2.30*	2.00*	2.60*	2.25*	2.26*
7	Lack of networking	1.85	2.15*	1.8	1.85	2.00*	1.93
8	Lack of patency	2.20*	2.30*	1.95	2.35*	1.80	2.12*
9	Lack of regulation in the innovation system	2.15*	2.40*	2.10*	2.55*	2.40*	2.32*
10	Lack of functional processing industries	2.80*	2.65*	2.65*	2.90*	2.70*	2.74*
11	Lack of adequate stakeholder interaction	2.00*	1.85	2.10*	2.55*	2.47*	2.19*

Source: Field survey, 2006, *serious factor.

order to enhance innovative performance of the soyabean innovation system in Benue State.

Conclusion

As a result of the major findings of the study the following conclusions were drawn:

(1) The major innovation introduced in the soyabean innovation system were soyabean milk and soyabean oil in the product/processing innovation category, the successful trial of improved high yielding, disease resistant, non pod shattering hybrid seeds (TGX – 1448 – 2E) and appropriate fertilizer type and rate recommendation in the basic research innovation category and the compulsory soyabean producers cooperative membership and the marketing strategy to by-pass middlemen in the sale of soyabean seeds.

(2) Among the product/processing innovation

introduced in the soyabean innovation system, soymilk was the most preferred innovation and was followed by soy cooking oil; while soya garri was least preferred.

(3) Ten factors were implicated as major factors hindering innovation in the soyabean innovation system. The major factors were lack of new knowledge, lack of research policy, lack of capital, lack of markets, lack of competent human capital, lack of research and extension, lack of patency, lack of regulation in the innovation system, lack of adequate stakeholders interaction and functional processing industries.

RECOMMENDATIONS

(1) Policy makers and implementers should mitigate the ten factors highlighted as major factors hindering innovation in the soyabean innovation system. Specifically, by encouraging the creation of new knowledge and research through

legislation of private sector funding of research and training of competent manpower, legislation of funding arrangement that will make aggressive private capital available from banks and interested bodies for establishment of soyabean processing industries. Also provision of tax holidays and infrastructure to encourage the investment in this regard. Also policies to generally improve markets, infrastructures, market information, information and communication technology (ICT) infrastructure and private sector funding of soyabean activities should be put in place and implemented. Also, exportation of soyabean should be encouraged by legislation to ensure that banking facilities are made available for investors interested in soyabean exportation. Above all, farmers who are capable of cultivating soyabean on a large scale and traditional soyabean farmers are encouraged through provision of inputs and extension services and insurance cover.

(2) The innovation introduced in the system

should be nurtured and patented by the regulatory bodies. This will encourage further innovation in the soyabean innovation system.

(3) The four product innovation, given high acceptability ratings by respondents shall be guaranteed funding by commercial banks to commercialize them to stimulate further innovation in the system.

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