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INNOVATION TECHNOLOGY TO ACHIEVE SOYBEAN SELF-SUFFICIENCY IN INDONESIA: HUMAN CAPITAL PERSPECTIVE

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ABSTRACT
Soybean is one of the main and very strategic food commodities in Indonesia. This paper aims to describe the opportunity to achieve soybean self-sufficiency from human resources perspective. The ability of human resources in understanding soybean technological innovation is determined by factors of knowledge, perception, attitude and motivation of individual farmer. The research was conducted from 2019 to 2020 in Bima Regency, West Nusa Tenggara Province, Indonesia. This research used an action research. The follow-up study in producing soybean seeds involved 50 farmers. Data and information were collected using observation, note-taking, focus group discussions, and interviews using a structured questionnaire. The collected data and information were then analyzed using descriptive and qualitative statistical analysis methods. The results of research that specifically observe human capital which includes knowledge, perception, attitude and motivation variables in the application of soybean seed technology have increased. Farmers' knowledge about soybean production and seed technology has increased by 78.86%, farmers' perceptions of soybean production and seed technology innovation were 82.23%, farmers' attitudes towards soybean seed and production technology innovations were 78.87% and farmers' motivation to apply production and seed technology were 79.91%. The increase in soybean productivity is determined not only by the availability of quality seeds, but also by the quality of human capital in implementing technological innovations. The quality of the application of soybean technology innovation determines soybean self-sufficiency to be achieved in a sustainable manner.

KEY WORDS
Human capital, soybean self-sufficiency, technology.

Indonesian soybean needs increase every year, in proportion to the increase in population. Efforts to increase production continue to be carried out, although the soybean harvested area tends to decrease every year. Sahputra et al (2012) stated that the decline in soybean area was caused by the inability of local soybean to compete with imported soybean, the lack of availability of quality seeds, the application of technology that was not optimal, and market prices that were not profitable for farmers. This causes farmers to be less motivated to grow soybean. In addition, Nugroho et al (2015) in their research in Gunung Kidul Regency revealed that one of the obstacles in the development of soybean farming is the difficulty of obtaining seeds during the growing season. Swastika (2005), in fact doubts that Indonesia will achieve self-sufficiency in soybean in the short and medium term. Therefore, one of the efforts made to increase production is to produce and disseminate seeds of high quality new improved varieties.

Quality soybean seeds are seeds that have been certified, that have met the requirements and already have a permit from seed breeding. Handayani et al., (2018) emphasize that a sustainable soybean development strategy requires using strengths to take advantage of opportunities through: (1) Using certified seeds in accordance with government regulations and policies; (2) Utilizing soil fertility levels and cropping patterns to meet soybean demand; and (3) Utilizing human resources by becoming a member of farmer

groups. Montania et al., (2021) explained that it is necessary to promote the adoption of technologies and mechanisms to meet demand without compromising natural resources.

The soybean seed system is expected to shape the attitude of farmers in the use of seeds, so that in the end farmers are able to evaluate certain seeds in meeting their needs (Insani and Nurmalina, 2014). In addition, farmers' preferences for the use of superior seeds were very influential in maintaining the consistency and continuity of domestic soybean production. However, there are problems faced by soybean farmers in the province of West Nusa Tenggara, namely the availability of high quality seeds, availability of irrigation water as well as pests and diseases. The same thing was also reported by Jaybhay et al (2018) that irrigation facilities, weed management, product marketing, pests and diseases were the top five obstacles faced by farmers in soybean cultivation.

Various processed foods use soybean as a raw material. Likewise with animal feed, not a few use soybeans as basic ingredients. However, it is unfortunate that during the last three decades, Indonesian soybean production has experienced negative growth. During the period 1992 – 2018 (26 years), the highest soybean production in Indonesia was achieved in 1992, namely 1.87 million tonnes, which was obtained from a harvested area of 1,665,706 ha with a productivity of 1.122 tonnes/ha. After 1992, production decreased to only 985,598 tonnes in 2018, which was obtained from a harvested area of 680,373 ha with a productivity of 1.444 tonnes/ha (BPS, 2017). The rate of production growth in this period decreased by -1.82% per year due to a decrease in harvested area with a declining growth rate of -2.28% per year. Although there was an increase in productivity in the same period with a growth rate of 1.10% per year, it was not able to increase production as a result of the decline in harvested area by 59.15% in the same period.

The decline of soybean production in Indonesia is caused by several factors, namely: 1) the decline in the competitiveness of domestic commodities against rice, corn, sugar cane, horticulture and other commodities, soybean farming is less profitable in terms of productivity and relatively low soybean prices; 2) a decrease in international competitiveness, cheaper imported soybean products, thereby suppressing domestic soybean prices; 3) the invasion of imported soybeans, because tariff and non-tariff protection are minimal, import and distribution restrictions do not exist; 4) regulation of soybean trading system is not conducive, among others there is no market guarantee, there is no government purchase price (HPP), import duty rates continue to decline; 5) the use of cultivation technology has not been optimal so that productivity growth is slow, and 6) seed storability is low (3 months), unattractive to seed producers/breeders (Suherman; 2014).

Socio-cultural-economic problems of farmers also contribute to the development of soybean farming and development of soybean agribusiness. Applying standard cultivation technology for soybean cultivation needs to be socialized and strengthened at the producer farmer level. The amount of acceptable and competitive income through soybean farming will determine the success of efforts to increase national soybean production. Guidance and assistance through counseling to adopt standard soybean cultivation needs to be done, especially for farmers who are not used to growing soybean (Sudaryono, 2010). Nurahman and Kurniati (2021) argued that some farmers tend to combine local knowledge and simple technology inherited from their parents with technology recommended by the government in carrying out soybean farming.

Human capital which includes knowledge, perception, attitude, and motivation is an important factor that must be considered in assisting the application of soybean technology. The four variables of human capital have a relationship or are related to each other in measuring the quality of human resources. This paper aims to describe the opportunity to achieve soybean self-sufficiency from the perspective of human resources.

MATERIALS AND METHODS OF RESEARCH

The study was conducted from 2019 to 2020 in Bima district, West Nusa Tenggara (WNT) Province of Indonesia. This research used an action research. The follow-up study in producing soybean seeds involved 50 farmers. Determination of locations and farmer groups

were done purposively. Determinations of the location of Bima district as the location of this study on the grounds that Bima district is one of the centers for soybean production in the province of West Nusa Tenggara. Soybean seed production is carried out through technical assistance and guidance, discussions and hands-on practice.

Collecting of data and information using observation, note-taking, focus group discussions, and interviews using a structured questionnaire. Human capital variables include: knowledge, perceptions, attitudes and motivations of individual farmers regarding innovation in soybean production and seed technology. Qualitative data and information were analyzed using qualitative analysis methods through the process of codification, categorization, meaning, and abstraction (Purwandari, 1998). The categorized and quantified ordinal data were then analyzed using descriptive and qualitative statistical analysis methods (Sugiyono, 1997).

RESULTS AND DISCUSSION

Farmers' knowledge on soybean seed and production technology. Farmer's knowledge about innovation, especially about soybean innovation, is always related to the application of the innovation. Low knowledge of technological innovations will have an impact on the quality of implementation. High farmer knowledge about soybean seed technology is a measure that the level of understanding about innovation will strengthen self-reliance in business.

Asaad and Sugiman (2018) stated based on their research in Southeast Sulawesi that the causes of the low use of quality seeds at the farmer level, namely (1) the limited availability of certified seeds, (2) the high price of quality seeds, and (3) the lack of understanding of farmers in the use of quality seeds.

The limited understanding of several components of soybean seed technology can be obtained through communication and innovation information networks with technology sources. Information on technological innovation can also be obtained by farmers from farmers who have succeeded in soybean farming or obtain it from extension officers who assist in the application of technology. Sani (2018) explained that increasing knowledge of innovation in increasing production in addition to the ease of accessing production inputs is also the most important thing, namely counseling on production technology. Counseling and learning about agricultural technology with farmers significantly gives farmers confidence in technology (Maertens et al., 2020). Innovation communication is an important element in increasing the capacity of farmers regarding soybean seed production technology. Almost all components of soybean seed production technology by farmers have a moderate to high level of understanding. The average level of knowledge of farmers regarding soybean seed production technology was 78.86%.

Table 1 – Farmers' knowledge level on soybean production and seed technology

No.	Technology components	Maximum score	Average score	Percentage (%)
1	Soil preparation and tillage	25	20,00	80,00
2	Seeds use and treatment	13	11,08	85,23
3	Sowing	10	8,10	81,00
4	Weeding	10	7,79	77,90
5	Fertilizing	19	15,24	80,21
6	Irrigation	5	3,96	79,2
7	Pests and Diseases control	10	7,28	72,80
8	Harvest and Post-harvest	10	8,08	80,80
9	Seed producing	44	33,60	76,36
	Knowledge level	146	115,13	78,86

Source: primary data analyzed, 2019.

After farmers understand the soybean seed production technology, of course there will be questions that arise in the stimulus regarding the advantages of the technology offered. Individual farmers or soybean seed producers will understand the technological innovation through the perception process.

Farmers' perceptions of soybean production and seed technology. Innovation is all ideas, methods or objects that are perceived by someone as something new. Someone thinks it's new, but it's not necessarily the same idea that's new to someone else. Through the perception process, an individual farmer still needs additional information to strengthen his belief.

Perception is a stimulus that hits the farmer and is then organized and interpreted so that the individual is aware of what he or she is sensing. When farmers hear or see a technological innovation, a stimulus that is received by their senses appears, then through the process of perceiving a new technological innovation that is captured by the senses as something meaningful and beneficial to them. However, farmers still need to prove the truth of the innovation through trials or looking at fellow farmers who have tried it.

Farmers' perception on soybean seed production technology innovation is a process of organizing and interpreting the stimulus received by farmers through group meetings, training, observation, technological assistance and field meetings, so that the soybean seedling technology innovation is meaningful and useful. Soybean seed production business independently is an integrated activity within the farmer before taking the decision to behave. The form of behavioral need is an individual action to implement technological innovation that has been believed and proven. The average perception of farmers regarding soybean seed technology innovation reaches 82.23%.

Table 2 – Farmers' perceptions on soybean production and seed technology

No.	Technology Elements	Maximum score	Average score	Percentage (%)
1	Soybean cultivation technology provides benefits for increasing production	5	4,32	86,40
2	Soybean cultivation technology in producing prospective seeds is relatively easy and very profitable	5	3,88	77,60
3	Soybean cultivation technology increases income and profits	5	3,80	76,00
4	The production achieved in the application of soybean cultivation technology is no different from the use of the previous technology	4	2,88	72,00
5	The use of new improved soybean varieties increases production compared to other varieties	5	4,08	81,60
6	New improved soybean varieties can be used if they are readily available and inexpensive.	5	4,12	82,50
7	To use a new improved varieties of soybean, it is still necessary to see evidence of its superiority	5	3,84	76,80
8	The new improved soybean varieties used has adapted well and has high production	5	4,04	80.80
9	New improved varieties selection is based on experience so far	4	3,88	97,00
10	The selection of new improved soybean varieties is adjusted to land, climatic conditions, and water availability	5	3,83	76,60
11	Use of soybean spacing as recommended	5	3,92	78,40
12	Soybean plants are fertilized according to the recommended dose	5	3,80	76,00
13	During the soybean seed production process, plants must be free from weeds and pests.	5	4,04	80,80
14	Processing of prospective soybean seeds into quality seeds is relatively very easy to do	4	3,64	91,00
15	Producing soybean seeds is more profitable than producing soybeans for consumption	5	3,92	78,40
16	Application of soybean cultivation technology based on reference sources for extension officers and researchers from WNT AIAT	5	3,96	79,20
17	Application of soybean cultivation technology based on the reference source of ILETRI researchers	4	3,80	95,00
18	Application of soybean cultivation technology based on reference sources from fellow farmers who have applied and experience so far	4	3,76	94,00
19	Application of soybean cultivation technology based on agricultural extension officers reference sources	5	4,08	81,60
20	Processing of soybean seeds based on agricultural extension officers reference sources	4	3,08	77,00
21	Processing of soybean seeds based on reference sources for researchers and extension officers of WNT AIAT	4	3,92	98,00
	Farmers' perception	98	80,59	82,23

Source: primary data analyzed, 2019.

Farmers' perceptions on soybean seed technology or soybean seed production technology are quite high. This proves that farmers will implement the innovation, but still go through behavioral processes such as farmers' attitudes towards innovation.

Farmers' attitudes regarding soybean seed and production technology. Farmers' attitudes are divided into 3 aspects, namely cognitive aspects (farmers' knowledge and beliefs about innovations), affective aspects (feelings about technology), and conative aspects (the tendency to apply technology). Attitude is a reaction or response that arises from an individual to an object which then shapes the individual's behavior towards the object in certain ways. Attitude is also defined as an assessment process carried out by an individual towards an object such as technology.

The cognitive component (perceptual component) is a component related to knowledge, views or ideas, beliefs and concepts. The affective component (emotional component), which concerns a person's feelings associated with beliefs, such as feeling happy or not happy with the object of attitude. The conative component (behavioral component), namely the component related to the tendency to act on the attitude object. This component shows the intensity of the attitude, which shows the size of a person's tendency to act or behavior towards the object of attitude. The behavior of farmers towards technology adoption if the technology provides benefits according to the goals they want to achieve. Added by Suharyanto et al. (2017) that a farmer who has a high attitude towards change then a program will be judged in terms of whether it is easy to implement, in terms of profit and loss, complicated aspects whether or not and whether or not to apply.

The fact that farmers' attitudes towards a technological innovation are influenced by individual internal factors (individual personality characteristics) and external factors (factors outside the individual). However, what are more dominant in influencing the attitudes and decisions of farmers towards an innovation are external factors. External factors include norms, habits, social communication, social interaction, and individual social learning of farmers in the social system. Communication and social interaction is concerned with providing the required production inputs. De Castro et al. (2021) emphasize that the human capital effect on productivity and the agricultural frontier expansion.

The cognitive aspect of 76.33% shows that most farmers have an understanding that soybean seed production technology is very necessary to meet the needs of seeds in the village area. Farmers have used seed production technology, but it is not optimal. Farmers know that there are still many elements of technology that have not been maximized. The results of the research by Kumar et al (2018) show that farmers' knowledge on soybean technology is still low, so that farmers' attitudes on technology is classified as moderate.

Table 3 – Farmers' attitudes regarding soybean seed and production technology

No.	Attitude Component regarding Technology	Maximum score	Average score	Percentage (%)
1	Farmers' beliefs about soybean seed technology (cognitive aspect)	84	64,12	76,33
2	Farmers' feelings about soybean seed technology (affective aspect)	64	49,16	76,81
3	The tendency of farmers to apply soybean seed technology (conative aspect)	125	102,04	81,63
	Farmers' attitude	273	215,32	78,87

Source: primary data analyzed, 2019.

Through assistance provided, soybean seed producers are happy to accept the technology for seed production. The innovation information received by farmers is felt to benefit from increasing production. Affective aspects of farmers regarding soybean seed technology by 76.81% can increase yields and income.

The attitude of respondent farmers in choosing, being confident and daring to adopt new technology in Upsus activities in the three research villages is in the high category. This is because farmers feel there is attention from the government and there is a desire to change in farming to produce higher production. High confidence in this new farming

business because it was uses an integrated farming system through mentoring. Ogunsumi and Omobolanle (2011) explained that the majority positive attitude of farmers towards the technology chosen is an indication of the importance of increasing the adoption of sustainable agricultural technology.

The level of courage to take risks is one of the psychological factors of respondent farmers in facing various possibilities for decisions taken in farming activities. High skills are caused by farmers who are used to farming activities and farmers always attend training and counseling, farmers who do not understand usually directly learn from farmers who are already skilled. The desire of farmers to be able to carry out new farming activities is due to the desire to increase their production and income (Adawiyah, et al., 2017). It is different from the farmers in Myanmar and in Malwa (Win and Chumjai, 2009; Dupare et al., 2019) that farmers do not understand the technology components well so that the level of application of the technological components of soybean production is relatively low to moderate.

Feelings of pleasure towards information technology received through mentoring encourage the growth of a tendency (conative aspect) of 81.63% to try and implement innovations. Seed producing farmers agreed to apply technology to increase the availability of seeds in village areas and areas that are centers of soybean production. In general, the attitude of farmers to soybean seed technology is 78.87%. Even though it is still classified as moderate, farmers and seed producers will optimize the use of innovation to improve the quality of the seeds to be produced.

Farmers' motivation regarding soybean seed and production technology. Motivation can also be referred to as encouragement, desire or human need in carrying out certain activities (Morgan, 1961; Rogers 1971). Motivation has three aspects, namely: (1) several conditions of motivation that encourage a person to lead to a goal, (2) motivation that encourages behavior that is displayed in achieving goals, (3) achievement of goals. Farmer productivity variable can be explained by motivation of 21%, meaning motivation is an important variable to consider in explaining farmer productivity variable.

Motivation for success will appear with the needs and desires. Both of these things affect behavior so that impulses arise, then the impulse will form behavior in the form of efforts to achieve goals. Farmers who have high success motivation are farmers who have a very large desire to succeed. Some of the characteristics of farmers who have high success motivation are farmers who have clear goals in their work, have self-confidence, show competition, have pride, are able to accept assignments, are willing to accept criticism and suggestions for improvement, and are willing to accept risks.

The motivation of farmers in soybean seed production is a set of value systems adopted as a driving force in individuals to try to make changes in behavior that are better in meeting their needs. The value system is one of the elements of culture, namely things that are considered good or bad, appropriate or inappropriate in living together in society (Soekanto, 1983). The value system is a navigator of one's behavior, so that the value system adopted by a person greatly determines the way of thinking, behaving, and impetus (energy) which leads to behavior in responding to every condition to meet their needs as individuals and meet the needs of their families.

A person's motivation to work basically boils down to the goals to be achieved such as the fulfillment of existence needs (availability of food, clothing, shelter, and a sense of security), social relations, interaction and mutual cooperation and partnerships with various parties, and needs of capacity building or growth (increasing knowledge about soybean seed innovation and soybean farming income through the application of innovation, participating in social activities) as a form of self-actualization.

The motivation of soybean seed producers to fulfill the need for existence is stronger (78.87%) and is almost the same as the motivation to fulfill the need for cooperation at 78.93%. The motivation of farmers to fulfill the need for increased capacity or growth is higher at 84.89%. The motivation to fulfill the need for capacity building is stronger, so that it becomes the driving force for increasing the need for existence and cooperation. Cooperation is shown in group activities, collaboration with breeders and marketing of

results. Susilawati et al., (2021) stated that the factors that influence the motivation in the application of agricultural technology are internal factors (from within the farmers themselves) and external factors. For this reason, the measurement of motivation consists of physiological motivation, sociological motivation and fulfillment of needs or self-actualization.

The needs for existence, partnership, and capacity building or growth are the components that motivate farmers to implement soybean seed innovation as recommended in order to increase production and income and profits. Seed and fertilizer subsidies that have been given by the government to soybean farmers have not strengthened farmers' confidence in increasing soybean production. It is different in China that subsidies for seeds and fertilizers as well as crop rotations issued by the Chinese government have actually increased farmers' interest in soybean cultivation (Liu et al., 2019). The income obtained by farmers from soybean farming is used to meet needs based on predetermined priorities. Fulfilling the need for family food availability is the main thing besides clothing, children's education, housing, and saving, as well as meeting the needs of innovations that arise simultaneously.

Soybean farming activities always establish cooperative relationships with fellow farmers, successful farmers, extension officers, seed certification agency, Department of Agriculture, production facilities kiosks, farmer group administrators, breeders and traders to obtain information on needed innovations and marketing.

Table 4 – Farmers' motivation levels regarding production technology and soybean seeds and production technology

No.	Motivational Component Regarding Technology	Maximum score	Average score	Percentage (%)
1	Fulfilling the need for existence	64	49,20	78,87
2	Fulfilling the need for cooperation or relatedness	71	56,04	78,93
3	Fulfilling the need for capacity building or the need for growth	53	44,99	84,89
	Farmers' motivation	188	150,23	79,91

Source: primary data analyzed, 2019.

There are several things that cause the lack of motivation of farmers in growing soybeans. Hadi and Wijaya (2016) revealed that trauma in soybean farming in the past seasons and the absence of policies and protection from the government regarding floor price setting caused the low motivation of farmers in soybean farming in Jember Regency. Sani (2018) reports several motivational factors that encourage farmer participation in growing soybeans, including easy access to new improved seeds, fertilizers, insecticides, herbicides, marketing and prices. In the WNT province, the price of soybeans for consumption received by farmers has not been balanced by the financing issued by farmers. The appropriate soybean price is one of the factors that strengthens the motivation of farmers to increase soybean productivity. Roessali et al. (2019) argued that soybean development can be sustainable if soybean prices are stable and provide economic benefits.

The motivation for success of farmers has a positive relationship with farmer productivity, namely the stronger the motivation for success, the higher the productivity of farmers in working on agricultural land, and vice versa. Therefore, the success motivation of farmers is an important variable to consider in an effort to increase soybean productivity.

A study conducted by Indraningsih (2011) in the Prima Tani Program shows that although farmers only prepare land and labor, but if farmers are included in the implementation planning, and given the trust to implement it themselves (with guidance by local extension workers who have been trained by researchers), then within the farmer will grow a sense of "ownership" of integrated farming technology. This will motivate farmers to really understand integrated farming technology, so that farmers will be able to decide to continue or modify the technology. The Food and Agriculture Organization (FAO) (1990) has identified several types of decisions that can be made by farming households, based on orientation to (1) production, (2) use of resources, (3) investment, (4) liquidity, namely the

amount of cash needed by farming households, (5) processing and marketing, and (6) communities (such as participation in a farmer organization, status improvement, and community expectations of farming in terms of production).

Production facilities that are available in the right quantity, quality, price and time as well as the existence of financial institutions that provide services to farmers will greatly support the success of farming, giving rise to positive perceptions and encouraging farmers' motivation in implementing new changes (Rukka, 2003).

CONCLUSION

Humans or individual farmers are the main actors in increasing soybean productivity. Farmers as the main actors must have strong human capital in applying soybean production and seed technology. Assistance carried out intensively in the study led to an increase in knowledge, perceptions, attitudes and motivation of farmers regarding soybean production and seed technology. The increase in soybean productivity is not only determined by the ability and availability of sufficient production inputs, it is also determined by human capital factors in managing soybean technological innovations. The quality of human capital regarding soybean technological innovations is closely related to the quality of the application of soybean technological innovations, thus encouraging the achievement of sustainable soybean self-sufficiency.

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CONFLICT OF INTERESTS

All authors clearly declare that they have no competing interests.

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