Identification of problem and needs in technical innovation to increase the productivity of rice, corn, and cattle in the Upsus region (national strategic program) in Central Sulawesi

Femmi Norfahmi1, Mardiana1, N.M.Rameda1, S.Panikkai2, A.B.L. Ishak1
1 Central Sulawesi Assessment Institute for Agricultural Technology, Central Sulawesi
2 Research Institute for Maize and Cereal, Jl. Poros Maros, Sulawesi Selatan

Email: femmi_norfahmi@yahoo.co.id

Abstract. The study was conducted in Central Sulawesi. This study aims to identify the problem and needs in technical innovation services to increase the productivity of rice, corn, and cattle in the upsus region. UPSUS is Special Effort Program from Ministry of Agriculture to increase the production of strategic commodity. Base on data in 2015 the harvested area of rice in Central Sulawesi was 203,918 ha with a total production of 1,001,949,19 tonnes. Compared to 2014, rice production in 2015 was decreased (1,006,437 tonnes). For corn, the harvested land of corn was 32,502 ha with a production of 131,123 tonnes, and the productivity of 4.34 tonnes per hectares. In 2014, the harvested area of corn was higher which was around 41,647 hectares with production 170,201.3 tonnes and productivity of 4.87 ton per hectare. The lower harvested land and production in 2015 compared to 2014, there was a decreased productivity in rice and corn. Donggala regency had the biggest population of cattle farming system in 2017 with the number of cattle around 42,217 cows, and most cattle were located in Dampelas sub-district (8816 cows). The decreasing production of rice and corn are caused by the reduced harvested land area and nonoptimal use of technological innovation. Technological innovation is also a necessity in increasing the production of cattle and the income of farmers. Adoption of innovation of technology has showed the best result to increase the production of rice 86% and corn 44%. The result of this study indicates that technological innovation is one of the solutions for the problems facing by the farm households, specifically for technical problems, such as the integrated crop management of rice and corn and cattle preservation technique. Additionally, farm households need technological information to increase the production and their farms’ productivity which lead to the increasing income and welfare of farm households.

1. Introduction
The food security program is one of development strategy that should be conducted together by the government and society as mandated by the cabinet that the sustainable self-sufficiency of rice, corn and soybeans has to be accomplished within three years. To support the program, the Ministry of Agriculture has established the Special Effort Program for increasing the production of rice, corn and soybeans (UPSUS Program) through the minister of agriculture’s decree [1]. One of the UPSUS Program is through the improvement of the irrigation system program and its supporting facilities.

In Central Sulawesi, the contribution of crops to the Regional Domestic Income (PDRB) is in the second position (14.73%) after plantation (24.09 percent). The harvested land area of rice farming is
around 203,918 hectares with total production of 1,001,949.19 tonnes [2] which is lower compared to production in 2014 around 1,006,437 tonnes. In 2015, the harvested land area of corn was 32,502 ha with the production around 131,123 tonnes and the productivity of 40.87 quintals per ha. The harvested land area, production and productivity also decreased from the previous year. On the other hand, the target of rice plantation in 2017 was 274,495 ha, but the realization was only 246,018 ha (89.63 percent) [3]. The decreasing production was caused by the reduction in planting area and the harvested area as well as the nonoptimal utilization of technological innovation. Central Sulawesi had been targeted to add the planting area (LTT) of rice to 282,775 ha and corn 130,198 ha. On the other side, there was an increasing demand for food consumption because of the increasing population. Since food is one of the basic human needs, it is the responsibility of government and society to fulfil the needs. In 2018, demand to rice seeds nationally was 422,492 tonnes, while the demand of Central Sulawesi to rice seeds was only 6,544 tons. The national target production of rice was 80.08 million tonnes in 2018, whereas the target production of rice commodity in Central Sulawesi was only 1,069,206 [3].

Donggala regency has the potential to develop cattle. The potential development could be seen from the livestock population in the regency. The regency has so much livestock in Donggala Regency such as broilers, pig, sheep, buffalo, beef cattle and horse. The biggest livestock population in 2017 was beef cattle around 41,217 cows, and most beef cattle were located in Dampelas sub-district (8,816 cows) [4]. The livestock sub-sector could be a solution for farm household to increase their welfare since the livestock in Donggala Regency provides opportunities in the future. However, Winarso et al. (2005) [5] describe that in reality, there are still many problems to be solved in developing cattle farming system. The potential of livestock in the region could not only be seen from the data and numbers, but also from many aspects through research and scientific approach [6].

2. Materials and Methods
This research was conducted in 2018 using a survey method. The survey was located in Donggala regency and Palu city, Central Sulawesi Province. The location was purposively chosen since the location is the production center of the rice, maize and cattle and Donggala Regency as the location of UPSUS program. The data used are secondary and primary data. Primary data (cross section data) was collected based on the interview with 30 farm household respondents who have rice farming. The farm households were selected with simple random sampling. Secondary data were obtained from previous research results and data published. The data were analyzed descriptively related to farm household characteristics, the identification of problems and needs for rice farming technology.

3. Results and Discussion
Farm household has two roles. Farm household could be the consumer of goods and service that they produce by themselves or by others. On the other hand, the farm household could also play a role as producer of agricultural products. Farmers are main actors in the agricultural development that play a very important role in increasing the productivity of agricultural products. The rapid development of technology will give significant impact to the increasing farming production and productivity that will substantially lead to the rising income and welfare of farm households. Therefore, effort in developing farming management is also important and could not be separated from the important role of agricultural technology. Figure 1 explains that there are two problems faced by farmers such as non technical problems (farmer group institution and the limited numbers of human resource) and the relative low level of knowledge in the location. The average education of local farmers in the location are junior high school. Non-technical problems faced by farmers are the limited access to fertilizers and pesticides. Other problems are the seed system and the seed breeder that are weak and not exist, and thus, most farm households could not use high-yielding varieties of rise seeds (VUB) but the local seeds which is generally obtained from other farmers. Farm households also have to face other problems related to technical factors including: (1) pest organisms (OPT) on rice (rats, stem borer, blast, tungro and crackle); (2) the use of local seeds obtained from the previous yields; (3) unbalanced utilization of fertilization as recommended and farmers are rare to use organic fertilizers.
in their farming (4) the low of knowledge to the utilization of agricultural machinery; (5) lack of knowledge on cultivating/seedling technology especially for rice commodities, production and productivity. Therefore, technology has become very important to overcome the problems faced by local farmers. Those problems ultimately could be solved by controlling pests and introducing VUB of rice (Figure 1). Ikhwan [7] stated that problems in increasing rice yields are largely due to inaccurate application of technological components toward rice varieties planted in certain environmental conditions. Hence, the accuracy of selecting the technology components is a necessity to achieve maximum results.

The technological innovations introduced to farmers are not adopted as expected. Farmers are reluctant to adopt the technology because of the internal factors (farmers are not accustomed to technological innovation; farmers perceived the use of technological innovation as wasting time; and they do not understand the benefits of technology), and external factors coming from outside the farm household (high price of input production, limited capital owned by farmers, the inability of farmers to buy the input production). Farmers are difficult to apply the technology because the technology developed are not aligned with the real needs and problems faced by its users or it does not consider the adoption capacity of its users. As a result, the adoption to innovation of most farmer cooperators are low and farmers prefer to use their previous way of cultivation (traditional patterns).

Meanwhile, to some extent, technological innovation is important to improve farming productivity. Additionally, farmers also need various information on farming activities from the land preparation, production process, harvest and post-harvest handling (processing, storage) until marketing. Therefore, the technology introduced needs to be suitable with farmers’ need and it is very important to improve farming productivity. One of the efforts to study the preferences of farmers to technological innovation is by identifying or finding the information of farmers’ needs of agricultural technology through a survey and participatory assessment.

Figure 1 clearly indicates that the intensity of socialization on technology innovation in rice farm households needs to be enhanced. The increasing intensity of socialization could not be done without the role of extension workers. Therefore, the role of extension workers is very invaluable in disseminating technology to users, especially rice farmer households. By considering their problems and solutions, farmer households need information on the application of rice farming technology from the utilization of VUB, seed treatment, planting systems, fertilizing technology, controlling pest, until the optimal application of the agricultural machinery. By understanding the technology, it is expected that farm households are able to increase the productivity of their farming and finally could also increase their income. Widuri et al [8] explain that farmers need a strategy that can be practised to overcome the problems. One of the strategies is through the improvement and the advancement of cultivation techniques that are easily applied and profitable as well as expected to provide additional income for farmers.

The extent of farmers’ needs to agricultural information has a positive correlation to the level of benefits perceived by the household of the information accessed. This is rationale since the higher the information needs by farmers, the higher the expected benefits obtained by farmers from adopting the information. The information could be from various sources either from the meetings (face to face) or from the newsletter and electronic media [9].

Technology would be applied and developed if the potential of its users could be understood. The real problems and the needs of the users are very important to be identified comprehensively in advance. Therefore, the technology offered as the solutions could be attracted the users [9]. The need for technological innovation at the farmer level is different for each category of farmer/group. Factors that influenced the diverse needs of farmers are the land ownership, the education and income level, economic development in the region, capabilities, information services, and the cost of access to information.

3.1 Identification of problems and needs to technological innovation for beef cattle

To solve the problems in livestock development, it is important to introduce technological innovation of beef cattle. Kusnadi and Uka [10] stated that the successful livestock development in increasing production cannot be separated from the role of animal husbandry science and technology produced by the Agricultural Research and Development Agency, both in the form of the component as well as a technology package, which gradually applied in the agricultural business system. The Adoption of technological innovation requires assistance and guidance in the process of finding and applying information. Farmers need a variety of information to support
their farming such as information on technology for production, post-harvest as well as marketing. When the technology introduced is suitable for farmers’ need, the increasing productivity of farming could be achieved. Therefore, it is important to consider the suitability of technology to farmers’ need. To understand farmers’ need for technological innovation could be done by identifying it through a participatory survey and assessment.

Every farmer group has different needs for technological innovation. The needs depend on the level of education, economic development in the region, information available, and the cost of access to information. The results of this study identify at least four basic problems faced by farmer respondents from technical aspect as follows:

1. Farmers have low utilization of seed with good quality because farmers do not have the ability to select good seeds in the farm. According to Winarso and Edi [11], the improvement in cattle breeding business is a necessity as a source of better feeder cattle and its cow in terms of quantity, quality and continuity. Farmers in Donggala Regency still tend to use the available feeder cattle without assessing the potential production of these cattle.

2. Most beef cattle have not been caged because the farmers do not realize and understand the importance of the cage for their livestock.

3. The cattle do not have good performance because farmers do not provide the cattle with high quality feed and concentrate, and farmers feed their cattle by leaving them around the field and thus, they will eat grass or others. Meanwhile, Hardiosuwignyo [12] and Sugandi [13] explain that grass has low productivity and nutritional value.

4. Bad performance of cattle (thin) is usually caused by worm disease. The cattle with traditional rearing system generally will be vulnerable to the risk of worm disease because they graze freely or find their own feed.
Figure 1. Identification of problems in rice farming household
The results of this study also identify some non-technical problems faced by farmers such as the following:

1. The access and farmers’ ability to agricultural technology are still low. Andriaty [14] mentioned how technological information in beef cattle is still left behind because farmers could not have access to the information on beef cattle’s cultivation.
2. Farmers have limited funding and the sources of funding from the third parties are still limited.
3. Farmers have a low level of knowledge on beef cattle technology (low-level human resources of farmers).
4. There are not many livestock groups in the area, while a group is a unit of people (farmers/breeders) who work together to achieve one or several goals that could not achieve individually [15].

Technological innovation is very important in order for farming to be more organized and better. Technological information is needed to access the information on innovation for increasing breeders’ welfare.
The decreased of beef cattle productivity

Non-Technical Problem

Cultivation Technology Information Still Behind

Limit of funding source

The low of human resources

Limited Cooperation facilities

Farmer Knowledge about Cattle Cultivation is still Low

Lack of livestock groups

Low Business Capital

Low Source Capital

Technical Problem

The Infection of Cattle with Disease

Skinny Beef Cattle

Livestock Have Not Been Caged

Seedling Quality Still Low

Cattles are infected by wormy

Potluck Feeding

Farmers do not want to build cages

Seed selection has not been applied

The decreased of cattle income

Imports of Live Cattle / Beef

The purchasing power of society is decreased

Figure 2. Identification of problems in beef cattle farm households
3.2 Identification of problems and needs of technological innovation on corn farming at Petobo Urban Village Palu City

Farmers are the main actors. Farmers are not only the consumer of goods and services that are produced by themselves and others but also the producer of agricultural production. Farmers have an important role in increasing the productivity of agricultural yields. The identification of problems on corn farming could be seen in Figure 3. The rapid technological developments will certainly give a significant impact on increasing farming productivity and farm household income, the production itself has increasing 44%.

The needs of farmers to technological innovation are different for each category of farmer/group, and it depends on the level of education, economic development in the region, information services, and the cost of access to information. This study has identified the basic problems faced by farmer respondents from technical aspect as follows:

1. Farmers do not apply balanced fertilization (appropriate dosage and time) as recommended. Farmers do not know and apply the upland soil test kit technology (PUTK).
2. Farmers are reluctant to implement the technology for controlling pests and plant diseases, especially for rice commodities. Pests include grasshopper pest and stem borer. Weeds are a competitor of corn in obtaining the nutrient, but the farmers do not know how to control/eradicate the weed appropriately.
3. Farmers generally use local seeds that are available in their village because it is difficult to have VUB (they have not understood and applied the VUB technology as recommended).
4. Farmers do not know and apply agricultural machinery. On the other hand, labour salary is high (Rp. 80,000 per person or IDR 2,000,000 per ha), while for harvesting, farmers still use the threshing machine.

The results of this study also identify some basic problems faced by farmer respondents from non-technical aspects such as:

1. The inexistence of seed breeder has lead farmers to use local seeds.
2. The human resources at farmer level are still relatively below recommended and lack of information on agricultural technological innovations to support rice farming activities.

Farmers could get benefits from the demplot in the form of information from several sources either meeting (face to face), printed or electronic media [16]. According to Burhansyah (2017) [17], to identify the needs of farmers to agricultural technology in a specific location is very important. This means that the technology created is demand-driven or appropriate with the farmers’ needs. Therefore, farmers will be encouraged to use the technology. As mentioned by Rifianto [18], one of the efforts to encourage farmers to use the technological innovation is by identifying their needs to agricultural technology and this could be done through a survey and participatory assessment. Andriaty et al [16] explained that the needs on the information in the farmer level depend on their education and income level, economic development in the region, information service capabilities, and the cost of access to information. This study shows that most farmers need the information on technological production is (80 percent), followed by marketing information (72.50 percent) and the information on technology for processing product (70 percent) (Table 1). The results are reasonable. Farmers will first find on how to improve the productivity of their farming because it will substantially increase their income. The information on agricultural technology has an important role in agricultural development. The availability of information on agricultural technology will develop agricultural business [19]. The existence of information on agricultural technology will directly give an impact to the farmers’ needs on the information.
Figure 3. Identification of problems in corn farm household
Table 1. The need of technological innovation based on commodities in the farm household respondents

| Commodity                        | %    | Commodity                        | %    | Commodity                        | %    |
|----------------------------------|------|----------------------------------|------|----------------------------------|------|
| ICM Rice (Jajar Legowo Super component) | 8    | ICM Corn                         | 27   | Cattle                           |      |
| New high-yielding varieties with high potential production | 11   | New high-yielding varieties, hybrid/composite | 27   | The selection of best breeds     | 20   |
| Biodecomposer, given together with tillage (second plowing) | 33   | High quality and labeled seeds    | 15   | Paddock recommended as           | 20   |
| Seed treatment: the application of organic fertilizer on seed and balanced fertilization based on upland soil test kit | 14   | Population 66,000-75,000 plants/hectare | 7    | The application of high quality feed and concentrate to livestock as needed | 35   |
| Controlling the pests using organic pesticides and inorganic pesticides based on threshold control | 25   | Fertilization according to the plant’s need and soil nutrient status | 18   | Controlling livestock diseases    | 25   |
| Agricultural tools and machinery, especially for planting (jarwo transplanters) and harvesting (combine harvester) | 9    | Agricultural tools and machinery, especially for planting, harvesting, and post-harvesting | 8    | -                               |      |

The data on Table 2 describes that the average number of dependents in the households which are underage or under 15 years is one person per household. This will determine the numbers of family members who are active in the on-farm, off-farm, and non-farm. Family members who are actively working in the farm are productive assets if they join the labor force and they are invaluable for farming development. On the other hand, the number of dependents will also certainly affect the household expenditure, either for food consumption, non-food or education. The number of dependents in the household will be consumptive assets if they are still underaged or do not work on the farm. According to the data in Table 2, the members of most farm households in location sample are over 15 years. The higher the number of family members with over 15 years of age, the working hours on the farm and the income from the on-farm, off-farm, and non-farm activities will also be greater. This is reasonable since the family with many labor force will also have to fulfil many things for their life. Conversely, the smaller number of dependents of household members over 15 years, the smaller expenditure of labor and income in the on-farm, non-agricultural and in non-farm activities will be.

Farming experience is a process of learning and it is the best teacher in the farming practice. By having enough experience, farmers will accept and choose easily agricultural technology that is appropriate and convenient to use. Table 2 shows that farmers have the average experience of around 12 years. 12 years are long enough for farmers to explore or understand the stages of farming activities. Hence, if farmers adopt agricultural technology, it will certainly increase farming productivity and production.

Land ownership has an important role as the main asset of farming. In terms of land ownership, most land is owned and cultivated by themselves, and there are only a few farmers as sharecropper or cultivator. Table 2 illustrates that the average of land ownership is 0.9 ha. Farmers with the small size of the land will spend low working hour on the farm compared to farmers who have a wider land area. As a result, they will have time to do other non-farm activity to increase their income. According to Sikei [20], land size and family size will affect the labor allocation decisions. Non-agricultural job is necessary as one of the strategies to have more income or to fulfil the family’s needs. Sawit [21]
explained that the time period between planting and harvesting is usually used by farm households to do non-farm activities or other jobs in the non-agriculture sector.

The labor market is influenced by farm households who spend their working hour on the farm, off-farm and non-farm. When farmers have to do many farming activities (land management, planting and harvesting), they need not only their family labor but also other labor from non-family labor. When there is not much agricultural labor available, demand to non-family labor will increase and substantially will increase the wage of labor.

Farmers who do not have land to cultivate usually work as farm labor. They use other farmers’ land who are older and unable to do farm activities. If they want to have more income, they usually work on other people's land. Those farmers who are working on other people farms are only aimed to fulfil the needs of the family to food.

Farm households gain income not only from on-farm but also from off-farm and non-farm activities. Farmers with limited land plantation usually do not have enough income to fulfil their needs, and thus, they will try to find other jobs to get additional income. Non-agricultural activities give relatively a higher contribution to farmers’ income. Farmers will reallocate labor from one activity to another if the number of labour in an activity is more than the other. There are some farmer respondents who work in non-agricultural activities such as drivers, construction workers, and others (Table 2). Those farmers who work in non-agricultural activities use their leisure time while waiting for the harvest time or after they finish their farming activity. Therefore, they will have additional income for their households.

Farm households who work in non-agricultural activity will also work on their farm specifically during the busy time of farming. The changes in input or output price, labor salary, and the land ownership area will have a direct impact on farm household behaviour in generating income [22]. Farm households as a source of labor will allocate their time between production activities and leisure. Farm households will allocate their time between farming activities (on-farm and off-farm) and non-farming activities (non-farm). The members of the household usually work together on their farm. This is rationale since they aim to maximize their household income and the efficient use of household resources.

Table 2. Characteristics of farm household members in the location of study sample

| Characteristics                                      | Average |
|------------------------------------------------------|---------|
| Farmer age (years)                                   | 45      |
| Farmer education (years)                             | 9       |
| Number of household dependents (persons):            |         |
| < 15 Year (persons)                                  | 1       |
| > 15 Year (persons)                                  | 1       |
| Land area ownership (hectares)                       | 0.7     |
| Number of livestock ownership:                       |         |
| - Cow                                                | 4       |
| - Goat                                               | 3       |
| - Chichken                                           | 10      |
| Family members who are active in farming (persons)   | 1       |
| Rice farming experience (years)                      | 11      |
| Type of side job:                                    | Non-agricultural service workers, |

source: primary data analysis, 2018

In farming, farm households have to face the risk of failure in production. As a strategy to mitigate this risk, farm households often plant other commodities and they do not focus only on one commodity in the same or different land. Farmers own not only rice fields but also dry land that they use to plant horticulture products (chilli), and plantation products (coconut, clove, cocoa). Diversification is the type of farming where farm households plant different commodities either in similar or different land. The diversification of farming gives invaluable benefits to farm households especially for the households’ income. Income coming from the diversification farming depends on the types, productivity and market of its commodity.
Diversification of livelihoods could overcome many obstacles that farmers usually have to face in obtaining income, harvest failure and building capacity for investment. Furthermore, the diversification of livelihoods and non-agricultural sector growth in rural areas could also connect between agricultural and non-agricultural activities, absorb a surplus of labor, reduce the gap between rural and urban, as well as migration. The growth in the agricultural and non-agricultural sector could develop rural areas and influence the livelihood of farmers such as income, individual characteristics and households, livestock characteristics, risk and location factor. Meanwhile, access to information on credit and market will motivate farmers in conducting non-agricultural activities, and thus, farmers could reduce the risk and control the variability of return for some non-agricultural activities.

4. Conclusion
Problems that farm households have to face in non-technical aspects such as in farmer group institution, the limited capability of human resources, low access to fertilizers and pesticides, and the weak system of seed/availability of seed breeders in the region. The information that most farm households needed is related to the application of technology the utilization of VUB, seed treatment, planting system, fertilization, pest and disease control, and the optimization of agricultural machinery utilization. Meanwhile, for breeders, they need cattle breeding technology as recommended such as the selection of high-yielding varieties, housing systems, feeding and concentrate as well as controlling livestock diseases.

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