Optimization of corn commodity Warehouse Receipt System (WRS) in South Sulawesi based on system dynamics

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Abstract. The purpose of this research is to study various factors that influence farmers in using the warehouse receipt system (WRS) and to apply the warehouse receipt system policy scenario in South Sulawesi. The method used is a dynamic system. The simulation results of the actual model type are that the income obtained from the actual (existing) model using WRS is higher than the direct income (selling corn directly) without entering the warehouse (WRS), as well as real income (where 100% of the corn that is produced) entered the warehouse immediately sold at the time without any delay in selling). The ideal type of warehouse receipt system shows the result that there is a difference in income (lost profit/benefit loss) if it does not optimize the existence of the warehouse, in other words, the average annual loss of income is 113.5 billion. The model shows that by delaying the sale, the profit difference (difference in income) is obtained from 38.35 billion to 189.77 billion or an average of 113.5 billion per year. The scenario model was developed with the consideration of optimizing the ideal model, namely optimizing the difference in income obtained from selling delays of 30% with a strategy of increasing agricultural productivity through increasing farmer productivity, which can be done in various ways such as training, socialization, education, institutional Warehouse receipt systems must carry out changes to increase productivity and performance in the field, build strong stakeholder support between local and central government.

1. Introduction

A warehouse receipt is a document issued by a warehouse operator as evidence that a certain commodity with the stated quantity and quality has been stored in a certain warehouse by a designated depositor. When supported by an appropriate legal and regulatory framework, warehouse receipts become a formal financial instrument that allows depositors to pass a security interest on stored commodities to another party without requiring physical delivery, allowing warehouse receipts to serve as collateral for ownership for loans. Warehouse receipt financing, in theory, allows small farmers in developing countries to safely store their surplus in modern warehouses for sale at a later date when prices are higher while allowing them to use the stored commodities as collateral to secure loans. temporarily finance household consumption and investment needs. However, in practice, the financing of warehouse receipts is generally not adopted by small farmers in developing countries that provide it. It can be seen that warehouse receipt financing involves improbable transaction costs and complex risk transfers that reduce their value to smallholders. Rising prices during the marketing
season alone will not guarantee that smallholders will benefit from financing warehouse receipts. Prices must rise enough to cover the costs of storing and maintaining the commodity in the warehouse, including the costs of security, insurance, quality control, utilities, and rental of warehouse space. Prices must also rise sufficiently to cover some of the transaction costs incurred when storing the commodity in, and pulling it from, the warehouse, including transportation costs and the costs of valuing, cleaning, drying, and packaging the commodity to meet the regulated quality standards required for the issuance of warehouse receipts. There is potential for smallholders to obtain the premium price needed to cover the high costs of commercial warehouse storage and warehouse receipt financing [1].

Smallholders have limited access to credit for their agricultural activities due to lack collateral acceptable to formal financial institutions. Farmers sell immediately after harvest at low prices to ease their financial constraints, resulting in low incomes. To overcome these problems, a warehouse receipt system (WRS) is suggested as the best alternative scheme. As happened in Africa, Indonesia is experiencing the same WRS problem, which is that it does not have the legal and institutional framework to ensure the success of its operations. This system is mostly used by large processors, importers, and exporters to secure loans for their transactions, and is not available to farmers minorities who suffer the most from financial exclusion due to lack of collateral [2].

Increasing the productivity of smallholders as a way to increase their incomes and livelihoods. Focusing on how farmers can increase their yields and income puts them at the center of the change they want to see. The Warehouse Receipt System implemented will seek to demonstrate that smallholders are capable of change and that they should be treated as active partners, not beneficiaries. It is written on the premise that they are rational producers and consumers, who aspire to control their destiny [3].

According to Zakiæ. et. al (2014), the benefits of WRS have been empirically proven in several countries. In Africa, evaluating the implementation of WRS can provide many advantages in terms of trade facilitation, increasing the efficiency of marketing agricultural products, facilitating access to rural financial institutions, reducing price risk, and increasing the cost-effectiveness of public food. Onumah, 2002). In Indonesia, farmers participating in the WRS at Warungkondang Cianjur received a price increase of IDR 400-600 per kilogram of harvested dry rice (GKP), so that their income increased by IDR 2.2 million per hectare of a rice field (Ashari, Ariningsih, Supriyatna, Adawiyah and Suharyono, 2013). Similarly, with the implementation of WRS in Turkey, wheat farmers and corn farmers can increase profits by 2-18% and 12%, respectively [4].

The volatility ("market mood") of agricultural product prices has prompted the Indonesian government to issue Law Number 9 of 2011 concerning the Warehouse Receipt System and its implementing regulations in 2007, and the commencement of activities in this field in 2008. This policy is considered very important for help farmers solve product marketing problems and help them obtain credit from financial institutions. WRS is a strategy that replaces the minimum support price program and cash transfers with a public distribution system that targets poor households. Indonesia's WRS policy aims to help farmers by using a delay mechanism get a relatively more profitable price. The mechanism also helps the government control price fluctuations associated with seasonal agricultural products. SRG provides credit guarantees, storage space, and market information until the market stabilizes and prices rise. WRS contributes to the sustainability of the food supply chain by improving marketing and facilitating access by smallholders [5].

The introduction of warehouse receipts (WR) is expected to reduce this problem for small farmers. However, WRS is still not available to most smallholders who are faced with complicated lending procedures. Few studies have been done on WRS however; they are mainly concentrated on marketing. This includes a study conducted by Onumah (2014), which centered on the contribution of WRS in product marketing in liberal markets. Furthermore, Onumah's (2014) research focuses on the contribution of WRS in enabling farmers to access financial services in financial institutions. However, most of these efforts failed to improve access to financial services by smallholders. Therefore, little has been done to understand the problems smallholders face. It is necessary to know...
to what extent WRS has facilitated access to financial services for small farmers to increase their activities. Therefore, the purpose of this study was to analyze the contribution of WRS in facilitating smallholders to access credit from financial institutions [6].

The implementation of WRS in Indonesia has been slow since its launch in 2006. The financing system, WRS has not been widely known and fully understood by stakeholders. On the other hand, WRS only covers certain commodities, the main users are wholesalers, entrepreneurs in agriculture, the limited number of warehouses, and limited support from local governments. As a result, WRS is underutilized by farmers who are reluctant to use it. In some areas, warehouses remain empty or well-stocked below capacity due to competition from middlemen. Some warehouses also have limited human resource capacity, especially regarding managerial staff and warehouse managers, especially in South Sulawesi.

WRS and agricultural commodity exchange do create added value by connecting small farmers, financial institutions, traders through better supply chain management. Learning from the success story of the WRS in Cianjur and the existence of several areas with a surplus of commodities, it is hoped that WRS can be developed to the next level. Warehouse Receipt System that can run well so that the welfare and income of farmers, especially farmers can be achieved. South Sulawesi, especially Gowa Regency, has a high corn production in this case a commodity surplus. Learning from the successful Cianjur WRS is an example and how to learn from their success [7].

The Warehouse Receipt System in India is used to make it more attractive for banks to lend to the agricultural sector, to reduce the cost of public support for agricultural marketing, to reduce transaction costs, and to improve price risk management. Warehouse receipts can also play an important role in new policies that will make Indian agriculture more responsive to market opportunities and more competitive about world markets. The net profit potential for the economy is enormous. Government warehouses are present throughout the country. They have developed homogeneous storage and quality practices, and their warehouse receipts are accepted by most banks (Jonathan Coulter, Natural Resources Institute, 2000).

Optimizing the warehouse receipt system in Indonesia, especially in South Sulawesi as well as the government through the Department of Trade and Industry making WRS policy scenarios using the Dynamic system method. According to Wilson (2000), scenario planning is a generative approach to strategy that assumes a high degree of uncertainty in the business world. Scenario planning helps organizations in dealing mainly with external analysis. It is, in essence, concerned with developing innovative but reasonable "what-if" detailed and rigorous narratives and then designing strategic steps to meet these possibilities. Schoemaker (1997) describes scenario planning as “a disciplined method for imagining possible futures” (Schoemaker, 1997, p. 45). It tries to take executive thinking from “what has been” and “what works now” to consider alternative futures. Thus, scenario planning is involved with turbulence, uncertainty, and complexity [8].

So that it will produce a strategy that can be used directly by farmers, especially small farmers to increase the income and welfare of farmers. These policy strategies include: The Government of Indonesia encourages the development of a national warehousing and warehouse receipt system for agricultural commodities, as a major part of its policy to expand the physical availability of warehousing services, as well as make warehouse receipts the main tool of trade and trade financing across the country. This will be achieved by (a) creating a truly secure system, where warehouse operators are accredited before banks and the public at large, and where investors can build warehouses with the knowledge that they can obtain accreditation provided they meet strict official standards; and (b) remove all policy and legal constraints on the use of Warehouse receipts, Warehousing operators will belong to the public and private sectors, and special interest will be attached to the development of the private warehousing industry. All licensed warehouses are expected to exercise minimum professional standards to give depositors confidence, lenders and society at large. They will be encouraged to develop their code of conduct and regulate themselves to the extent possible, warehousing laws will be enacted, and formal regulatory authorities instituted to enforce standards and protect the interests of those holding warehouse receipts from negligence,
malpractice, or fraud. The regulatory authority will be structured in such a way as to ensure its full autonomy and freedom from political interference, the Government should establish a Task Force responsible for designing and implementing the system. It will represent a wide range of stakeholders, including those with practical experience in the commodity trade in question and trade finance. Based on the recommendation of Task Force, the Government will immediately act to remove obstacles in the form of restrictive legal regulations, taxes, or duties that seriously prevent companies from using warehouse receipts with predetermined priority commodities – including corn, grain, and seaweed commodities and the latest information technology will be used to develop a secure warehouse receipt system where ownership and liens can be clearly defined.

To understand how to optimize the warehouse receipt system in South Sulawesi, especially Gowa Regency, it is necessary to set a policy scenario using the dynamic system method, both in terms of the actual model type (existing model) and the ideal type of corn commodity warehouse receipt system. Therefore, it is possible to recommend policy scenarios that can be developed to optimize the warehouse receipt system in South Sulawesi.

2. Material and method

This study uses the Postpositivist paradigm. Postpositivist aims to describe the process and interpret the meaning behind reality, then the in-depth description and interpretation of meaning will be used by policymakers and change agents. In essence, the researcher tries to reveal how social reality is formed and maintained by certain individuals/groups and how to interpret it. The system conceptualization in this problem uses a dynamic system approach. The system dynamic method is an experimental approach method that underlies the observation of reality to understand the behavior of the system.

This research was conducted in South Sulawesi, especially in Gowa Regency, which implemented a corn warehouse receipt system. This research consists of primary data and secondary data. Primary data is data obtained directly from respondents including data on the description of the Warehouse Receipt system at that location and, how the ideal type is in the field as well as partial and global scenarios that occur in South Sulawesi, especially Gowa Regency. Secondary data is data obtained from the results of documentation studies and library studies such as receipts issued by warehouse managers, the amount of production of each commodity (corn, grain, and seaweed), data from the Gowa Agriculture Service, DESPERINDAG Provence, and Desperindag Gowa Regency.

Data collection techniques used in this study were observation, interviews, focus group discussions (FGD), documentation, and multi-media. The analytical tool used in this study is a dynamic system. In the form of a dynamic system as a modeling tool, it can be simulated and filtered according to stakeholder needs. In systems thinking, there are multidisciplinary and organized methods of planning and management, and non-quantitative thinking can be done. The information consists of input variables, output variables, and environmental variables that limit the model. Sterman (2000) explains that in a dynamic system, a description of the behavior of the system is obtained, which is interdependent and can change from time to time. A dynamic system is a feedback structure in which variables are interrelated and tend to be balanced [9].

The information structure of the modeled system Among them are participants, sources of information, and the information flow network that connects the two. System dynamics models phenomena based on historical data. The stages of implementing a dynamic system include the following:
1. Causal Loop Diagram (CLD)
2. Making Stock Flow Diagrams (SFD). Through this mapping, the relationship between the variables described in the CLD is fully clarified based on the quantitative records obtained.
3. Simulation, which is carried out based on the relationship between variables that have been designed in the SFD by looking at the actual model type (existing model) and the ideal type of warehouse receipt system.

The formula of this model is the stock and flow equation which transforms the system into a dynamic system model (Forrester, 1994). By performing simulations, it is possible to understand
inventory and flow behavior in dynamic systems. The software used to simulate inventory and flow charts is Powersim Studio 10 (Agriculture and Udayana, 2021).

3. Results and discussion

3.1. Dynamic Model Of Warehouse Receipt System For Corn
3.1.1. Causal Loop Diagram (CLD)

![Figure 1. Causal Loop Diagram (CLD).]
3.1.2. Stock flow diagram of Actual Model

Figure 2. Stock flow diagram of the actual model.
The results show that the income obtained from the actual (existing) model using WRS is higher than direct income (selling corn directly) without entering it in the warehouse (WRS), as well as real income (where 100% of the corn that enters the warehouse is immediately sold) at the time without any delay in selling.

Table 1. Comparison of Actual income (WRS) with no WRS (direct).

| Years | Actual Model Direct Revenue | Actual Model Real Revenue | Actual Model Ideal Income | GAP Actual Model Revenue | Ideal Revenue Scenario Model |
|-------|----------------------------|---------------------------|--------------------------|--------------------------|-----------------------------|
| 2021  | 1.35e12                    | 1.54e12                   | 1.56e12                  | 21,615,000,000.00        | 1.56e12                     |
| 2022  | 2.68e12                    | 2.77e12                   | 2.81e12                  | 38,353,656,000.00        | 2.81e12                     |
| 2023  | 4.01e12                    | 4.00e12                   | 4.06e12                  | 55,109,430,623.49        | 4.06e12                     |
| 2024  | 5.34e12                    | 5.24e12                   | 5.31e12                  | 71,882,323,870.47        | 5.32e12                     |
| 2025  | 6.67e12                    | 6.47e12                   | 6.56e12                  | 88,672,335,740.95        | 6.59e12                     |
| 2026  | 8.01e12                    | 7.71e12                   | 7.81e12                  | 105,479,466,234.91       | 7.88e12                     |
| 2027  | 9.34e12                    | 8.95e12                   | 9.07e12                  | 122,303,715,352.37       | 9.18e12                     |
| 2028  | 1.07e13                    | 1.02e13                   | 1.03e13                  | 139,145,083,093.31       | 1.05e13                     |
| 2029  | 1.20e13                    | 1.14e13                   | 1.16e13                  | 156,003,569,457.75       | 1.18e13                     |
| 2030  | 1.34e13                    | 1.27e13                   | 1.28e13                  | 172,879,174,445.68       | 1.32e13                     |

Figure 3. Type of Actual model (existing model).
3.2. *The ideal type of corn commodity warehouse receipt system*

![Diagram showing comparison of real income with ideal income](image)

**Figure 4.** Comparison of real income with ideal income (which should be received).

The results show that there is a difference in income (lost profit/benefit loss) if not optimizing the existence of the warehouse, in other words, the average loss of income per year is 113.5 billion. The model shows that by delaying the sale, the profit difference (difference in income) is obtained from 38.35 billion to 189.77 billion or an average of 113.5 billion per year.
3.3. What is the WRS Scenario either globally or partially

Figure 5. WRS scenarios both globally and partially

The scenario model was developed with the consideration of optimizing the ideal model, namely optimizing the difference in income obtained from selling delays of 30% with a strategy to increase agricultural productivity through increasing farmer productivity, which can be done in various ways such as training/socialization of WRS, the government makes warehouse receipts as the main tool of trade and trade finance across the country, warehousing laws will be enacted, and formal regulatory authorities instituted to enforce standards and protect the interests of those holding warehouse receipts from negligence, malpractice, or fraud, the Government should establish a Task Force responsible for designing and implementing the system. It will represent a wide range of stakeholders, including those with practical experience in the relevant commodity trading and trade finance. It can be seen that the scenario model developed provides better results in providing a significant increase in income.

Based on this scenario, the following model simulation results are obtained:
It appears that corn production is increasing very well. It appears that production in 2021 will increase by 1,762 tons or an increase of about 0.61% from the previous year. This condition indicates that the scenario model developed is quite good and provides a significant improvement.

Table 2. Difference between actual model corn production and Scenario model.

| Year | Actual model corn production | Corn production scenario model |
|------|------------------------------|--------------------------------|
| 2021 | 288,200.00                   | 288,200.00                     |
| 2022 | 288,494.74                   | 289,322.13                     |
| 2023 | 288,789.48                   | 291,084.98                     |
| 2024 | 289,084.23                   | 283,491.05                     |
| 2025 | 289,378.97                   | 296,544.26                     |
| 2026 | 289,673.71                   | 300,249.96                     |
| 2027 | 289,968.45                   | 304,614.93                     |
| 2028 | 290,263.19                   | 309,647.43                     |
| 2029 | 290,557.94                   | 315,357.14                     |
| 2030 | 290,852.68                   | 321,755.25                     |

The increase in production automatically provides a gap from the income obtained by farmers, both direct income, real income, and ideal income. Like the following picture:
Figure 7. Comparison of direct income between the actual model and the scenario model.

Figure 8. Comparison of real income between the actual model and the scenario model.
4. Conclusion

The conclusions that can be drawn from this research are as follows:

The income obtained from the actual (existing) model using WRS is higher than direct income (selling corn directly) without entering it in the warehouse (WRS), as well as real income (where 100% of the corn that enters the warehouse is directly sold to the warehouse), time without any delay in selling. The results show that there is a difference in the income obtained (benefit loss) if it does not optimize the existence of the warehouse, in other words, the average loss of income per year is 113.5 billion. The model shows that by delaying the sale, the difference in profit (difference in income) is obtained from 38.35 billion to 189.77 billion or an average of 113.5 billion per year. The scenario model was developed with the consideration of optimizing the ideal model, namely optimizing the difference in income obtained from selling delays of 30% with a strategy to increase agricultural productivity through increasing farmer productivity, which can be done in various ways such as training/socialization of Warehouse Receipt System, the government makes warehouse receipts as the main tool of trade and trade finance across the country, warehousing laws will be enacted, and formal regulatory authorities instituted to enforce standards and protect the interests of those holding warehouse receipts from negligence, malpractice, or fraud, the Government should establish a Task Force responsible for designing and implementing the system. It will represent a wide range of stakeholders, including those with practical experience in the relevant commodity trading and trade finance. It can be seen that the scenario model developed provides better results in providing a significant increase in income. It appears that corn production is increasing very well. It appears that production in 2021 will increase by 1,762 tons or an increase of about 0.61% from the previous year.

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