



FANRPAN

Food, Agriculture & Natural Resources Policy Analysis Network



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Improving Farmer Incomes through Post-Harvest Loss Management Technologies in Mozambique

Introduction

Substantial post-harvest losses in cereals and other staple food crops contribute significantly to food, income and nutrition insecurity in Sub-Saharan Africa. Food producers, consumers, their national governments and other food value chain players are failing to prevent staple food losses after harvest. Currently, total food losses in Sub-Saharan Africa are estimated to be worth \$4 billion per year, an amount which can feed 48 million people (FAO, 2013). Losses on cereals are estimated to be high and account for about 25% of the total crop harvested. The Mozambican government has put in place strategies to improve yields through research and extension services and improving agricultural infrastructure. Nevertheless, Mozambique continues to experience food deficits estimated at 400,000 tonnes per year. Although modern PHM technologies have been introduced in the major cereal producing regions the adoption rate has been low because the small-scale farmers and traders cannot afford the high costs.

Increasing Investment in Improved Post-Harvest Loss Management Technologies for Staple Grain Crops Will Reduce Hunger, and Improve Rural Incomes in Mozambique

Extent of PHL in Mozambique and Causes

Mozambique faces annual maize deficits estimated at 400,000 tonnes which are attributed by government to poor storage and marketing. On average, farmers store 500-1000kg of maize and 200-300kg beans. Storage losses for staple grain crops range from 20 to 40% depending on crop and geographical location. Post-harvest Losses (PHL) are experienced right from the field as some crops are harvested already infested by pests and insects. Significant losses are experienced

during storage and throughout the value chain to the table.

Small scale farmers and traders continue to use traditional crop storage techniques which are not effective in preventing losses. Modern PHM technologies have been introduced in the major cereal producing regions but the adoption rate has been low because the small-scale farmers who constitute the majority of farmers in Mozambique do not afford.

Economic and Social Implications of PHL

For a farmer that harvests and stores 1000kg of maize and loses 30% through processing and storage, assuming a selling price of MZN 28.80/kg during the lean season, their loss is valued at MZN 8,640.00. In the same vein a farmer that harvests and stores 200kg beans and loses 30% through storage, assuming a price of MZN 76.21/kg during the lean season loses MZN

4,572.60. Also, a farmer that harvests and stores 100kg cow peas and assuming a lean season price of MZN 38.11/kg loses MZN 1,143.30. These losses by individual farmers culminate into millions of Metical for the nation. For example, in 2013, the total maize production was 1,631,000MT, therefore 30% losses estimated at 489,300MT would be valued at MZN

14,091,840.00. These losses contribute to the 400,00MT food deficits experienced every year and exert unnecessary pressure for the government to import food.

Food is abundant soon after harvests and is sold cheaply on the markets and then short supplies are experienced during the lean season. Women spend a lot of time during the lean season looking for food which reduces their time on child care. This scenario contributes to high levels of chronic malnutrition (43% of under-fives are stunted) and under-weight (15% of children under-five years) which Mozambique experiences. Women are also deprived of opportunities to participate in social activities and decision-making processes, while children go hungry and fail to attend classes due to hunger or are forced

to get engaged in casual work to augment family incomes or acquire supplementary food for the household.

Furthermore, the agriculture value chain is deprived of sufficient high quality raw material to function optimally. Opportunities to trade and process the grains and create much needed jobs for the high number of youth entering the job market every year are lost resulting in persistent high levels of unemployment. Yet agriculture with appropriate introduction, promotion and adoption of improved post-harvest loss management (PHLM) technologies could play a major role in income generation for farmers and downstream job creation for value chain actors.

Benefits of Investing in PHLM

Recently a study was conducted to estimate the costs and benefits of using hermetic bags and metal silos for storage of maize, beans and cow peas in Mozambique.

The following methodology was used. Streams of incremental costs and benefits associated with the adoption of the metal silo and hermetic bag technologies were constructed in MS Excel, based on the knowledge available on PHLM practices of farmers in Mozambique. Net cash-flows were calculated based on the expected lifespans of the metal silos and hermetic bags (20 years and 2 years, respectively). To assess viability of the investments in PHLM technologies, five indicators were computed using the various scenarios of risk, farmer post-harvest management preferences and technology type, standardising the module (quantity stored) as 500kg. These indicators were net present value (NPV) (of the net cash flows), internal rate of return, benefit-to-cost ratio, payback period; and breakeven point.

In keeping with standard practice in CBA, the study established both the counterfactual and treatment scenarios for smallholder, medium-scale and large-scale farmers involved in production of maize, beans and cowpeas in Mozambique.

Both hermetic bag and metal silo technologies were found to be viable but to different levels depending on farmer practice and crop.

The results were as follows:

Maize and the Hermetic bag

- A farmer who used to sell all maize produce at harvest time and then invests in hermetic bags

over a period of 20 years and stores maize in order to sell during the lean season will get two and a half times return to his/her investment. The investment in the hermetic bags will give the farmer more benefits than the value the farmer gets when he/she sells at harvest time.

- Farmers who do not have a practice of selling their maize grain soon after harvest but store and lose up to 30% of their produce to post-harvest losses, stand to benefit immensely by investing in hermetic bags, whether or not they then consume or sell the preserved maize later in the consumption season. The benefits are more than three and half times the costs incurred. The payback period is only 3 years.



Hermetic bags

Source: <https://www.prlog.org/12221790-grainpros-supergrainbags-are-seen-here-being-used-for-coffee.jpg>

Maize and the Metal Silo

- If a farmer or trader desires to shift practice to production and storing of 1,500 kg of maize using metal silos rather than selling immediately after harvest, there is an added benefit of introducing metal silos to encourage him/her to store and sell at a higher price later during the lean season. The benefits are 6 times the value of costs and the costs incurred over 20 years can be covered by benefits realized in one year.
- Farmers (or traders) who do not have a practice of selling their maize grain soon after harvest but stores and loses up to 30% of their produce to post-harvest losses, stand to significantly gain more than those who have been selling at harvest.
- They will benefit by investing in metal silos, whether or not they then consume or sell the preserved maize later in the consumption season. The benefits outweigh the investment costs by approximately 759%.
- The metal silo remains viable even for farmers who will adopt and use it for shorter periods rather than the projected lifespan of the silos because the payback period is very short (1 to 2 years depending on assumptions of about the level of incremental benefits).

Beans and the Hermetic Bag

- A farmer who is able to produce and store beans but has a practice of selling his crop at harvest time, will stand to benefit if he/she changed to storing using hermetic bags and selling later in the season. The value of the additional benefits of the technology outweighs the incremental cost of the improved storage technology (hermetic bags) by about $3\frac{1}{2}$ times.
- For farmers who have a practice of storing and using the beans later, or selling them in the lean season, results confirm that even those non-adopters of hermetic bags with low post-harvest losses, stand to benefit if they were to adopt hermetic bags and eliminate the losses. The Benefit Cost Ratio value of 9.4 shows that the investment can recover the costs as much as 9 times during the 20 years of investment.

Beans and the Metal Silo

- For metal silos, and for farmers that would otherwise sell their beans immediately after harvest, the benefits would exceed the costs by



8.26 times. The results show that the investment will pay-off even for smaller production units.

- Farmers or traders who do not sell their beans immediately after harvest but choose to store for later use (sell or consume) will benefit even more from metal silos as the returns will outweigh the investment costs by approximately 2,100 percent (21 times). Such farmers who previously had as little as 1.3 percent loss in storage (not 29.8 percent) before adopting the technology, would stand to benefit if they were to invest in metal silos to store for sale or consumption later in the season and if they were to use the technology for 20 years.

Cow peas and the Hermetic Bag

- Where the farmer or trader has no tradition of storing cow peas, but sells immediately after harvest, showed that investment in hermetic bag technology would leave the farmer/trader better off, with benefits exceeding costs by 1.71 times.
- When the scenario of farmers that store cow peas for sale later in the season is considered these stand to earn higher incremental benefits from the hermetic bag technology (when compared to the period without technology), with a Benefit Cost Ratio of 4.7.

Cow peas and the Metal Silo

- Farmers who sell cow peas immediately after harvest, will benefit if they changed their practices to storing and selling later, and if they do so using the metal silo technology. The benefit to cost ratio would be 413 percent and the payback period would be 2 years.
- When the scenario where farmers do not sell their cow peas immediately after harvest but store using ineffective traditional methods is considered, results shows that metal silos would have a

significant impact on farmer incomes if they were to switch to them. Returns to investment would outweigh the costs by 1,036 percent (Benefit-Cost Ratio (BCR) of 11.36). Cowpeas producers who

intend to store for sale later are better off with metal silos than hermetic bags, but both options are viable. Farmers or traders can recoup the costs of this investment in the first 3 years.

Challenges Confronting Farmers and Other Value Chain Actors

With the high post-harvest losses food only lasts for 3 months after harvest after which it is lost due to poor storage conditions. Most farmers especially those in the central and northern regions of the country sell more than half their crop within three months of harvest in order to avoid physical losses. The large cereal harvests in the central and northern regions contribute to the surplus supply compared to demand of commodities on the markets soon after harvest thereby greatly depressing the prices. However, farmers who sell their crops at harvest lose the opportunity to sell at higher prices later in the year.

The prices then rise by about 200% during the lean season when commodities become scarce on the market. As consumers, the farmers have to access the same commodities which they would have sold cheaply earlier in the year at much higher prices.

A wide array of modern and improved PHLM technologies have been introduced to smallholder farmers in Mozambique through combined efforts of the Government, donor agencies, NGOs, universities, farmer organizations, the private sector and local governments, in a number of provinces. However, the adoption rates remain sub-optimal at around 40-60% because the farmers cannot afford the technologies. For example, metal silos whose price is over US\$100 per unit can store only one tonne of crop.

Hermetic bags are also costly because of the 37% import duty charged on hermetic material and the short lifespan of the bags (2 years). This implies that the bags have to be replaced with new ones every second year in order to maintain effectiveness of storage.

Low farmer incomes affect demand for metal silos because they are inadequate to provide the resources required as initial investment capital for farmers to adopt the new technologies. This in turn keeps farmers in a vicious cycle of traditional non-improved technologies, high losses, low incomes and low innovation potential.

Some of the metal silos that are manufactured are of poor quality because of raw materials that are of inferior quality and artisans that lack the requisite skills, tools and financial resources to procure high quality metal.

Micro-finance facilities which could be used by farmers to secure the much needed capital to purchase hermetic bags and metal silos are not widely available in rural areas of Mozambique due to high transaction costs faced by MFIs. These transaction costs are driven by high population dispersion, poor transport infrastructure, and a compromised credit culture, whereby farmers have become used to handouts from the Government or credit schemes that were not strict on loan recovery. For this reason, smallholder farmers are perceived by the banks and MFIs as a high risk group to lend depositors funds. The large land area of Mozambique also makes it difficult for any MFI to establish a branch network capable of reaching every corner of the country. A large share of smallholder farmers in Mozambique therefore face a significant challenge of financial exclusion from the formal financial system and rely on informal finance which have very high interest rates of the order of at least 10% per month as a minimum.

In a drought year such as 2016, the country had to import maize that is more than its normal import requirement (above 500,000 MT) to meet consumption requirement for 2016/17 consumption season. Nevertheless, this came at a huge cost to the limited foreign currency reserves of the country and the country had limited ability to meet these import requirements. Hence Mozambique had to rely on benevolence of well-wishers in the humanitarian community to meet the deficit. Such a situation is not sustainable and compromises the sovereignty of Mozambique. In addition, the country becomes susceptible to the vagaries of price fluctuations on the regional and global agricultural commodities markets. Worse still, food purchases crowd out essential imports of raw materials for industry including agriculture and has the impact of exporting jobs to those countries where the food imports will be coming from (E.g., South Africa and Brazil).

The focus of agricultural extension services on increasing productivity with little or no attention being given to post-harvest loss management remains a big policy and programming gap for Mozambique. Global evidence has shown that a dollar invested in improvement of yields produces much less return (1%) than that spent on reducing post-harvest losses (15%).

However, investments in yields have historically had a wider reach, been popular with the electorate and had a better appeal in messaging than those aimed at reducing post-harvest losses. Changing this perception requires significant investments in demonstrating the differential in economic gains from investing in yield improvement and reducing losses.

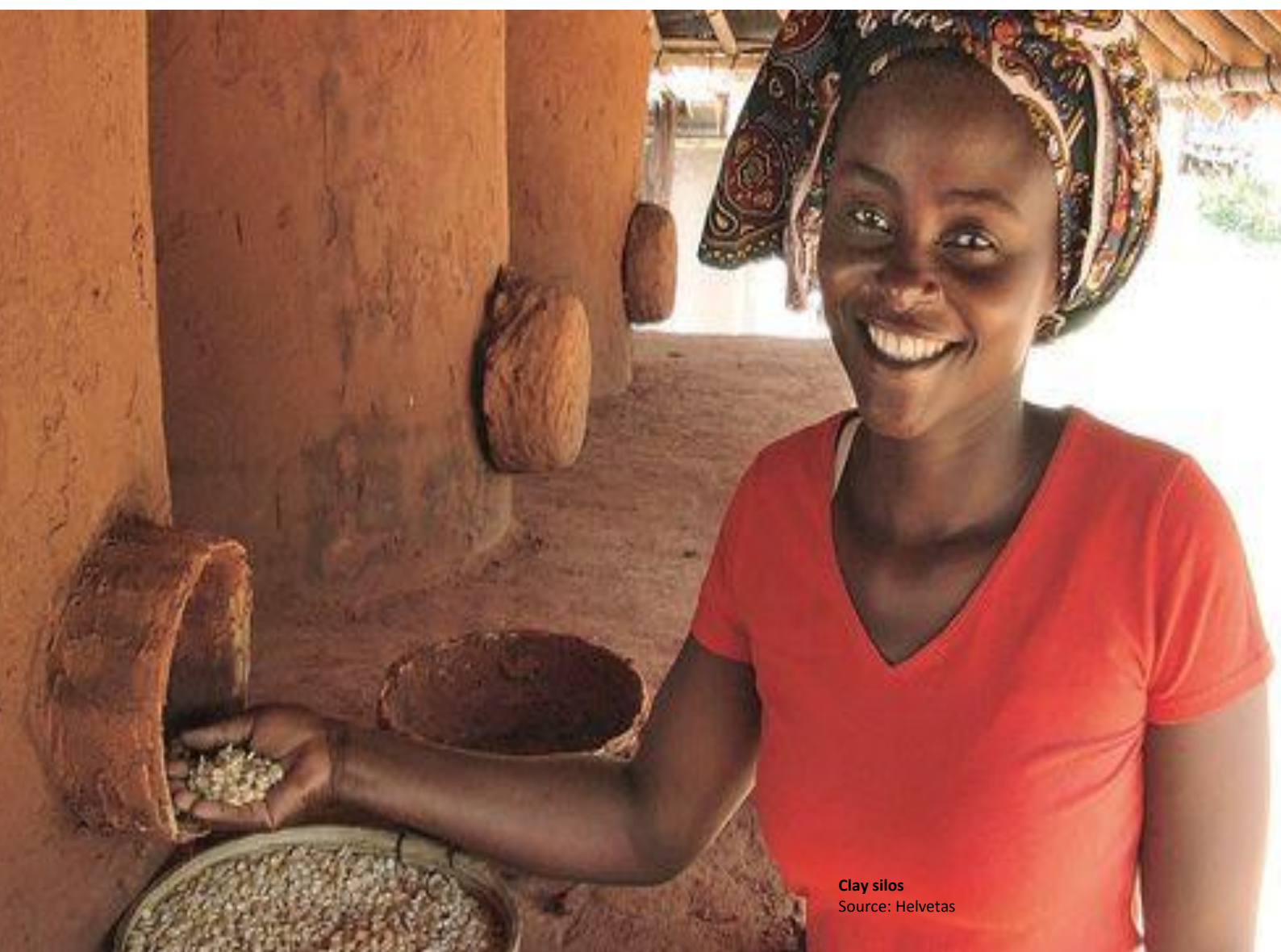
The warehouse receipt system which is novel and offers opportunities for farmers to store maize safely, whilst having a facility to access credit to invest in improved post-harvest technologies is not yet fully developed or widely understood among small-holder farmers due to literacy challenges and the limited reach so far of such systems.

Another major challenge hindering wider promotion and adoption of improved PHLM technologies in Mozambique is the policy vacuum on PHLM in general. While the country has the Strategic Plan for

Agricultural Development Sector 2011-2020 which contains a post-harvest management strategy, there is no stand-a-lone policy on PHLM. This weakens budget allocation through treasury to PHLM as well as institutional coordination and collaboration on the subject.

Research is limited on effectiveness of various PHLM in Mozambique (including the traditional, and semi-improved technologies such as Gorongosa Mud Silo) and there is a general lack of PHLM service providers.

Adoption of improved PHLM technologies is also negatively affected by a general lack of training institutions for PHLM, a weak government extension services system on the subject of PHLM.



Clay silos
Source: Helvetas

Recommendations

1. In order to strengthen interventions on PHLM, government is encouraged to develop a stand-alone policy that is aligned to the CAADP and SADC frameworks and should emphasize issues of research, dissemination of results and uptake, the role of different stakeholders, collaboration and coordination among stakeholders, investment by government, extension services and import duty on PHLM raw materials.
2. To increase the rate of adoption of hermetic bags by Small and Medium Scale Farmers, Traders, and Agro-industries, government and development agencies should strengthen the supply chain of hermetic bags, with the view to increasing efficiencies, exploiting economies of scale in their production, or importation and where possible encouraging government to co-invest by lowering import taxes on the bags. The private sector should be capacitated to manufacture the bags at scale and in a decentralized manner so that the bags can reach all of Mozambique's major grain producing regions.
3. Scaling-up hermetic bag and metal silo storage innovation in terms of extension activities should be considered by development practitioners (in government, the private sector and NGOs) as a prerequisite for building demand among farmers and traders that is large enough to attract more investment by the private sector into local supply of hermetic bags and metal silos in Mozambique.
4. Extension services should reach smallholder farmers to understand the importance of storage pest management. Technology use and transfer should be strengthened in Mozambique, especially targeting Cabo Delgado, Nampula, Niassa, Zambezia and Nampula provinces which are among the major grain producing regions. These initiatives, should use both traditional and non-traditional extension approaches, including demonstrations of the technology in targeted villages as well as promotion via community radio and television programmes, and cell-phone videos.
5. Government and development partners are encouraged to increase investment in PHLM activities so that all farmers and traders in all provinces have access to modern technologies. Financing for modern PHM technologies should be improved through increasing national budget allocations, promoting micro-finance companies' operations, budget allocations through the District Development Fund and warehouse receipt system. Banks and micro-finance institutions should be encouraged to accept warehouse receipts as security.
6. Cost benefit analysis of other PHLM technologies should be undertaken in order to inform farmers and provide them with a wider choice of viable options.
7. Government and development agencies willing to promote adoption of the metal silo technology should reach to farmers and traders willing to use the silo for at least 3 years, otherwise the investment will not be viable.
8. Given that the returns to investment for metal silos are higher than for hermetic bags and the payback period is shorter for metal silos than hermetic bags, post-harvest management programmes seeking to promote improved technologies over a shorter period of time should prioritize the metal silo ahead of the hermetic bag provided, all other things remain constant.
9. Given the high initial capital investment cost for the metal silo, PHM programmes seeking to promote adoption of improved storage technologies for maize in Mozambique should consider the hermetic bag technology for wider reach with limited resources ahead of the metal silo, but actively promote the metal silo as a graduation pathway for hermetic bag adopters. This is because metal silos offer a more viable longer-term preferred choice if the resources allow. Hermetic bags might look cheaper on the surface but due to their short life-spans (2 years), they are more expensive for resource poor maize farmers in the longer-term.
10. Given that returns to investment in hermetic bags for storage of beans are superior to those of maize by 229 percent (for those who do not sell at harvest), government and development agencies should consider promoting hermetic bags more for the storage of beans as opposed to maize if prioritization was to be made between the two crops. However, since the returns for maize are also high it would be worthwhile also to promote the technology for maize as well without any reservations, depending on farmers' technology preferences.



Metal Silos, Mozambique
Source: FANRPAN

References

1. Aulakh J., & Regmi A., *Post-harvest food losses- Development of consistent methodology*.
2. Chisvo M. & Jaka E. 2017. *Cost Benefit Analysis of post-harvest management innovations in Mozambique*. FANRPAN.
3. FANRPAN Policy Brief. 2014. *PHLM in Mozambique- Towards a Specific Post-harvest Loss Management Policy and Strategy for Mozambique*.
4. FEWSNET. March 2016. Mozambique Price Bulletin.
5. FAO. Improved post-harvest handling raises incomes for Mozambique farmers. <http://www.fao.org/in-action/improved-post-harvest-handling-raises-incomes-for-mozambique-farmers/en/>
6. Ngare L., Simtowe F., Massiguo J., 2014. *Analysis of price volatility and implications for price stabilisation*. European journal of Business and Management. ISSN 2222-1905. Paper ISSN -2839 (online). Vol. 6, No. 22.
7. Knoema Production Statistics- Crops, Crops Processed – February 2015. <https://knoema.com/FAOPRDSC2015Feb/production-statistics-crops-crops-processed-february-2015?country=1001320-mozambique&item=1000900-maize>.
8. Schneider K., 2014. *Post-harvest management in Sub-Saharan Africa- Feasibility study on promotion of Post-harvest technologies in the north of Mozambique- Mission Report*.
9. Tivana L., Casimiro A., Madzara M., & Monjane I. 2014. *Post-harvest management policy and strategies in Mozambique and Sub-Saharan Africa- Mozambique Report*. FANRPAN.

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About FANRPAN

The Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN) is an autonomous regional stakeholder driven policy research, analysis and implementation network that was formally established by Ministers of Agriculture from Eastern and Southern Africa in 1997. FANRPAN was borne out of the need for comprehensive policies and strategies required to resuscitate agriculture. FANRPAN is mandated to work in all African countries and currently has activities in 17 countries namely Angola, Benin, Botswana, Democratic Republic of Congo, Kenya, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe.

FANRPAN Regional Secretariat

141 Cresswell Road, Weavind Park 0184, Private Bag X2087, Silverton 014, Pretoria, South Africa
Telephone: +27 12 804 2966. Facsimile: +27 12 804 0600. Email: policy@fanrpan.org . Website: www.fanrpan.org