

Table S1. Practical nudging strategies and communication guideline for NBRS mangement.

sources of influence RSU	Self-motivation and ability	Social motivation and ability	Structural motivation and ability
1. rice straw compacting	• Farmers receive clear information on steps and benefits. (O1,1) (Attractive) • Joining a farmer group and the group possessed a compacting machine, so a queue system for compacting would be organized. (S1,2) (Easy) • Not joining a farmer group, the rice straw compacting company visited their rice field nearby the time of harvesting to book the rice straw, and came again after harvesting to compact rice straw. (O2,2) (Easy) • Confirmation of their motivation, aligning with the agreed-upon terms, made them satisfied and steadfast in choosing this method. (S2,5) (Attractive) • No need to have much knowledge and skills because of having the service at the rice fields. (O1,1) (O2,2) (Easy)	• Farmers in the same and nearby villages practice and share information. (S1,1) (Social) • Compacting provided for group members and non-group members with service charge, while return will be provided for group members as well. (S1,2) (Easy)	• Farmers experiment and realize the benefits of income generation, environmental advantages and other agricultural purposes. Rice straw is valuable for farmers growing vegetables/fruits to cover the soil and provide moisture. They compacted rice straw and keep inside their household for further usage. (S2,5) (Attractive)
	Limitation 1: small scale of rice cultivation and obtain not much rice straw (W1,4) Response 1: Governmental agencies should collaborate with the private sector, aligning with policies to incentivize the private sector in achieving Net Zero. (O2,2)	Limitation 2: a surplus of rice straw during dry season (W1,4) Response 2: Local authorities should take main action as a coordinator to contact business or private sector who need rice straw for their production, so that the surplus rice straw can be balanced and beneficial. (W1,3) (O1,1) (O1,2) (O2,2)	Limitation 3: the nature of farmland, seasonal factor, and urgency for the next crop to align with water release by the local irrigation authority (W1,4) Response 3: spreading fermented rice straw as fertilizer (O1,1) (W3,3): - wet rice straw can be used for mulching; - dry rice straw is required for feeding cattle
2. cattle farming	• Due to facing the water shortage for the second crop of rice cultivation as the hilly terrain with rain-fed agricultural area, where often proved with low yields, so	• Almost all farmers in the community continue cattle farming. (S2,5) (Social)	• Guidance and support from local livestock and agricultural offices since the first step of introducing until confirmation. (O1,1) (W3,3) (O3,3) (Timely)

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	local agricultural agencies stepped in to provide guidance and promote cattle farming. (W3,3) (Timely) • Positive experience and fewer barriers, so they remain cattle farming and intend to continue for a long time. Over the past 3 years of cattle farming, farmers have not encountered any severe epidemic causing deaths. They have taken preventive measures by vaccinating against diseases such as foot-and-mouth disease for free from the local livestock office and administer it themselves or hire someone to administer it for 20 Baht/cow. (S2,5) (Easy)	• Farmers help each other by sharing advice, and consult with local agricultural livestock officers. (S1,1) • (Social) Networking with local traders, while farmers can set the price of cattle selling. (S1,2) (Social)	• Farmers have realized benefits in terms of income generation, low cost and good for environment. (S2,5) (Attractive) • Farmers can set their own cattle prices for selling when they were 4 months to 1 year based on the market rates. The current prices are around 30,000-40,000 Baht for females and 20,000-30,000 Baht for males. Some buyers intend to raise the purchased cattle further for breeding. Furthermore, they can sell dried cattle manure for 20 Baht/compost bag. Growing grass, especially the varieties of Pangola, Napier, and Israel Sweet, not only for feeding their cattle, but also offers additional income of 1,000 Baht per ton or 3 Baht per kilogram. Farmers plant these themselves and grind the grass for storage. • Low cost was also perceived such as renting hilly land at 1,000 Baht per acre per year (20 acres) for cattle to roam and exercise, and utilizing household electricity for electric shock fences, costing around 100 Baht per month. • The farmers also realize from their practice to be benefited the environment because of avoiding chemical use in rice cultivation to ensure safe straw for their cattle. • Farmers reflected their perception of easiness and convenience such as during the dry season, cattle are released to graze, and in the afternoon, they return to their pens, allowing farmers flexibility for other activities. They need to prepare only: 1) the cattle area

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			by using available materials inside their household for wooden structures without the need for additional purchases; 2) rice straw and grass as the cattle food, which they can gain both from their own management. If these really are insufficient, they can purchase from other farmers inside or nearby their community. (S2,5) (Easy) • Moreover, it was easy to obtain blood for artificial insemination from both government sources (costs 200 Baht) and private sources (costs 1,200 Baht). Farmers can select blood from reputable sources, ensuring quality genetics and market demand for the calves. They realized that the artificial insemination practice was also easy to conduct by inviting a veterinarian to inject the cattle. This method has also proven more accurate and successful than natural breeding for three years, using purchased private blood. In addition, further support from the government will be building a nearby slaughterhouse, especially to support cattle farming. (S2,5) (Easy) • The Land Development Department will come to excavate and construct ponds for cattle farmers. (O3,3) (Timely) • The government will build a nearby slaughterhouse to support cattle farming. (O3,3) (Timely)
3. Carbon credit trading from rice cultivation	• Leading farmers participate and find it appealing because it aligns with their existing practices, involves simple steps, and does not add complexity. They have	• Several organizations, such as the Bank for Agriculture and Agricultural Cooperatives	• The practice is convenient and timely. (S2,3) (Easy, Timely)

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	been required to practice alternate wet and dry and NBRBS management, recording their practices through a mobile application. (S4,S2,5) (Easy) - As mentioned by one leading farmer, “It is simple and has become a habit to record via the mobile app for tracking and learning the outputs of my practice, whether it will yield good results or not.” Farmers already know how to practice based on their experience. (S2,4) (Easy) - They also learn the benefits based on their previous experience. They explained that "allowing the rice to dry during the tillering stage promotes root growth, enabling better aeration. Subsequently, flooding the field post-drying supports optimal rice development. It is crucial to ensure sufficient water during the initial months of rice cultivation; otherwise, weed growth becomes a significant concern." These perceptions encourage them to try this method. (S2,4) (Attractive)	(BAAC), and private companies, express interest in carbon credit initiatives and would like to cooperate with farmers to achieve their targets as well. (O2,2) (Social) Learn from successful farmers nearby, namely Suphan Buri, participate in carbon credit trading and receive compensation. Leading farmers in this study area also consult and visit successful farmer groups before adopting this practice. (S1,1) (Social)	The primary benefit lies in economic gain, especially in terms of income without significant effort, while considerations for health and the environment are secondary concerns. Other farmers, upon hearing about this approach, express interest in joining as it fits into their current farming methods. The process is manageable for those not burning rice straw, utilizing irrigated fields, and the mobile app conditions are easily met. The seamless integration of taking photos and reporting online is seen as convenient and timely. (S2,3) (Attractive)
	Limitation 1: Lack of trust in the management and implementation of the program due to experiencing receiving no compensation from attending the program. The reliability of the system's operations is crucial for sustaining farmer confidence. (T2,2) Response 1: (S1,1) (S2,3) (S2,4) (S3,4) (T2,2) (T3,2) - Governmental agricultural authorities should take the main action to collaborate with farmers and non-governmental or private sectors. To address farmers' distrust of private companies, GIZ (a German development agency) is suggested to engage directly with farmers and possibly purchase carbon credits themselves,	Limitation 2: Alternate wet and dry practice during the rainy season, water management (inflow/outflow) becomes challenging in rainfed fields. (T3,2) Response 2: Suitable areas are those near natural water sources such as rivers, canals, or wells. (T3,2) Limitation 3: During the rainy season, carbon credits are not	Limitation 4: Some farmers face more drought than wet conditions, making alternate wet and dry practice less feasible. (T3,2) Response 4: This practice seems not to be practical, especially in the dried area based on rainfall. To be more practical, this practice should be provided as an alternative based on the season and the topography of rice fields. (T3,2)

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	or conducted through the district and sub-district agricultural offices. - Conditions and terms for compensation should be clearly communicated, offering higher compensation for both wet-dry rotation and non-burning methods.	earned as because water remains in the pipes or cannot be dried. (T3,2) Response 3: The company understands this natural condition and still provides payment. (O4,3)	
4. Rice Straw Compost	• Farmers firstly knew and learned how to do this from agricultural extensionists and lead farmers. Then, they had a chance to practice during the group activity. (S1,1) (S3,4) (social)	• There normally has the group activity of making microbial fermentation water together in a group and bringing it back home for usage, or some farmers also make it at home. (S1,2) (social) • (social) Government agencies promote knowledge and support agricultural equipment. (O1,1) (O3,3)	• The geographical location leads to the more worthwhile to practice rice straw compost than continue the second crop. (O3,3) (Easy)
			Limitation 1: Perception of complexity and wasting time due to the requirements of water, composting, and urea fertilizer. (T1,2) Response 1: Emphasize the positive outcomes, particularly in reducing the need for additional fertilizers, including a straightforward explanation of the process. (S1,S3,3)
5. Soil covering by rice straw	• Farmers who use their rice straw for soil covering also grow vegetables and/or certain types of fruits or practice integrated cropping. (S2,4) (Easy) • Soil covering is not difficult to do and does not require specific skills. (S2,4) (Easy)	• Lead farmers who adopt soil covering with rice straw have observed from their practice that the rice straw helps to retain soil moisture, so they share this	• Using rice straw as mulch for vegetable plots offers advantages, making this method attractive for farmers. (S2,4) (Attractive) • After one season, the rice straw transforms into compost, enhancing soil fertility. Repeating this process 3-4 times improves soil structure, as observed

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		knowledge with other farmers in their group. (S3, 4,1) (social)	by the presence of earthworms and other beneficial organisms. Recognizing healthy soil involves observing the presence of earthworms and other soil-dwelling insects. A good practice is to feel the soil – if it crumbles into a powdery texture without clumping, it indicates fertility. When using rice straw for winter mulching, apply a thick layer during midday watering sessions. Avoid watering in the morning or evening during colder weather to prevent fungal growth and ensure plant development. • Farmers with GAP certification for vegetable cultivation attract customer interest. Not only will sustainable and diversified farming be encouraged, but also the long-term benefits of utilizing straw as a valuable resource in agriculture will be emphasized. (O2,2) (Attractive, Timely)
	Limitation 1: Some farmers did not employ integrated cropping and thus did not adopt this practice. (W2, 4) Response 1: Diversifying crop cultivation by encouraging farmer groups to engage in selling vegetables could be beneficial. Factors such as personal interest, readiness, and proximity to supportive cooperatives can drive success. (W2,4) (O2,2)		
6. Plowing rice straw into the soil for fields		• Farmers in the same contextual area also utilize this method because they realize its effectiveness for rice straw management. (O2,4) (Attractive)	• Farmers understand the necessity of waiting to see the positive effects of this practice, which could reduce fertilizer usage by over 50%. (S2,2) (Attractive)

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		Limitation 1: For dry conditions and sun exposure, late plowing causes the rice straw to become sticky and challenging to incorporate. (T3,4) Response 1: Immediate rice straw plowing needs to be practiced. (S2,2) (T3,4)	Limitation 2: For wet conditions (T3,4) Response 2: Spreading and mixing rice straw right after rice harvesting (S2,2) (T3,4)
7. Products from rice straw	• Motivation: Farmers had less self- and social-motivation to continue producing the products due to time-consuming, not cost-effective, and unable to make a profit. (-Easy) (T4,5)	• The leading farmers still remember how to practice and can transfer their knowledge and skills to other farmers. (S3,1,4) (social)	Limitation 1: Farmers are still uncertain about the profitability of this method. (T4,5) (-Attractive) Response 1: The success in implementing this method relies on the agreement and support of community leaders, local organizations, academia, and consumers. (T4,6) (Easy, Social, Timely)
8. Mushroom growing	• This method is not very popular. Although they have received knowledge and training, when they tried it, the mushroom yield was low. (-Attractive) (W4,2,4)	• Very few farmers in the study area employ this method, so this also lacks social motivation and ability. (-social) (W4,2,4)	• This method requires minimal rice straw. (-Attractive) (T4,4)
9. Biomass energy	• This practice is relatively new and not very popular in the study area. There is inconsistency or changes in the conditions of purchase. (-Easy) (W4,2)	Limitation 1: Transporting rice straw to distant areas poses safety concerns. (T2,2) Response 1: Facilities for inside factory with a safe environment based on a participatory approach need to be considered. (W4,2) (T2,2)	Limitation 2: Trust and openness operation need to be declared similar to carbon credit trading. (T2,2) Response 2: Efforts need to be made to instill confidence in farmers. (T2,2)

Note: at the end of each sentence the letter referred to S = Strength, W = weaknesses, O = opportunity, T = threat; followed by five main aspects of the RSU: 1 = information, knowledge and guidance; 2 = system management including products from rice straw; 3 = agricultural resources (land, water, time, labor); 4 = practicing or experience sharing; and 5 = decision support